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WINDOWS NT: THE REAL STORY

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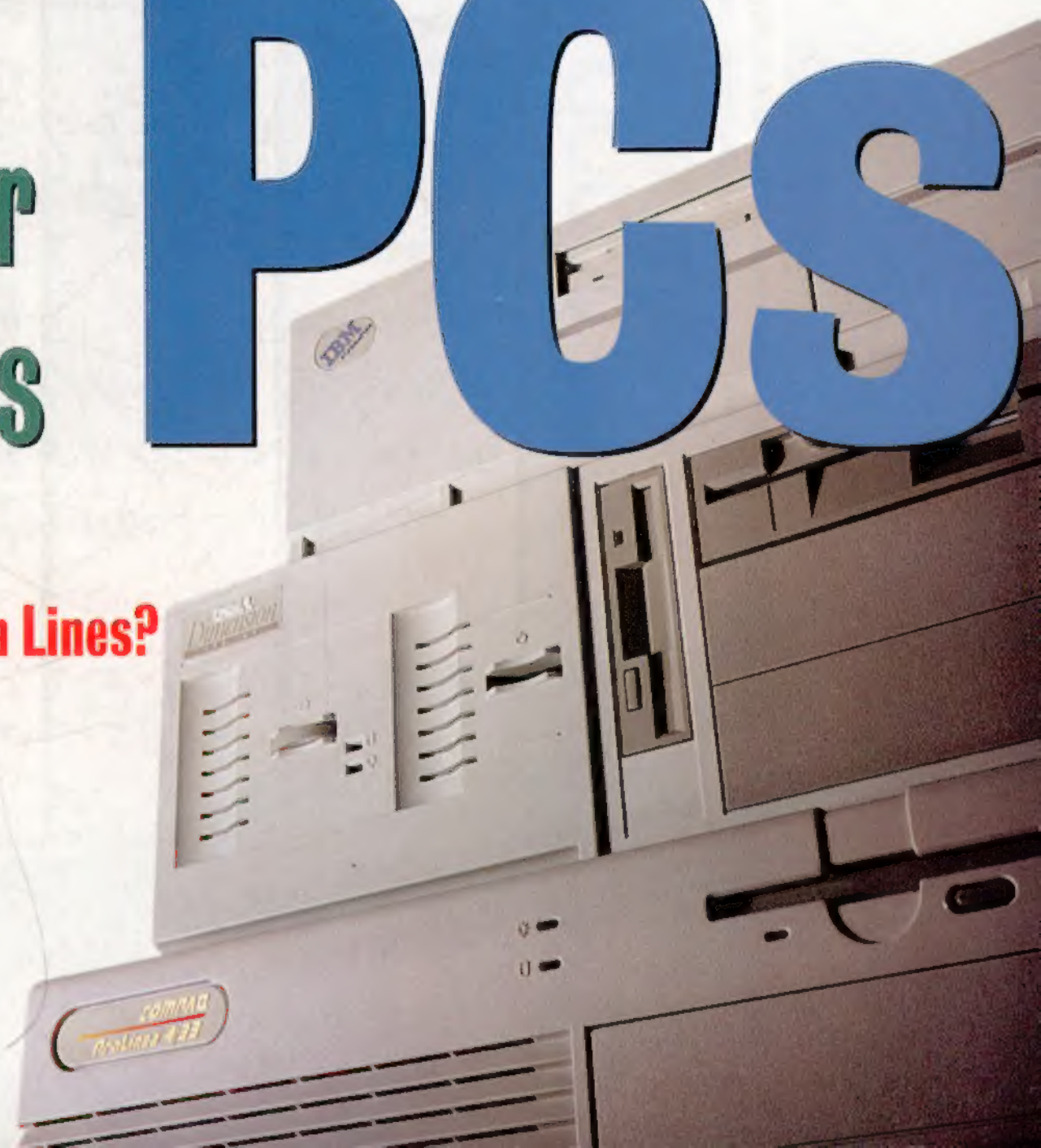
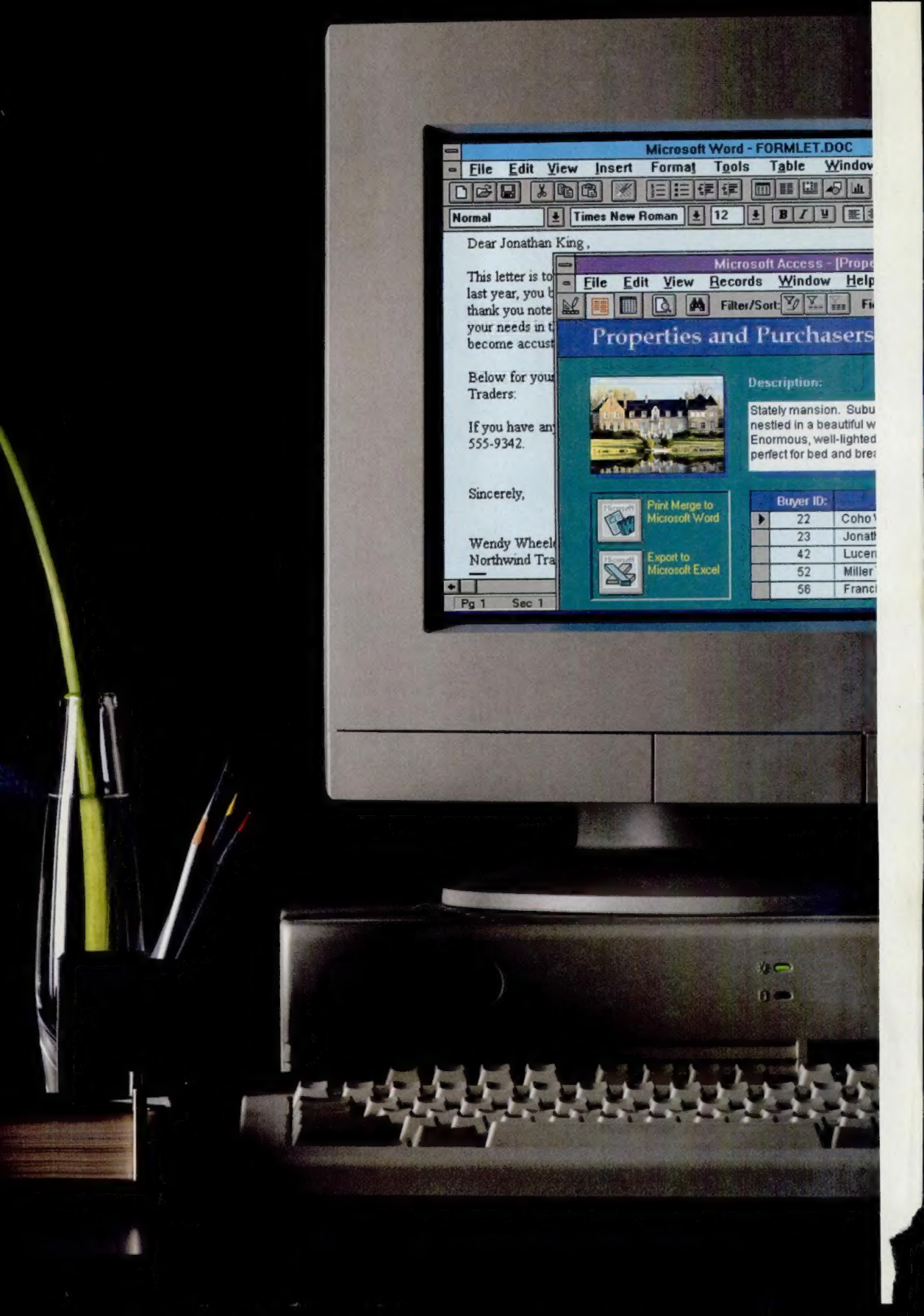


ANNOUNCING THE FIVE BEST PLACES TO WORK IN AMERICA.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Predefined Object Classes	YES	NO	NO
Variables Modifiable in Debugger	YES	NO	NO
Customizable Reactive Error Handling	YES	NO	NO
Reads and Writes FoxPro (.CDX) Files	YES	YES	NO
Reads and Writes dBASE IV (.MDX) Files	YES	NO	YES
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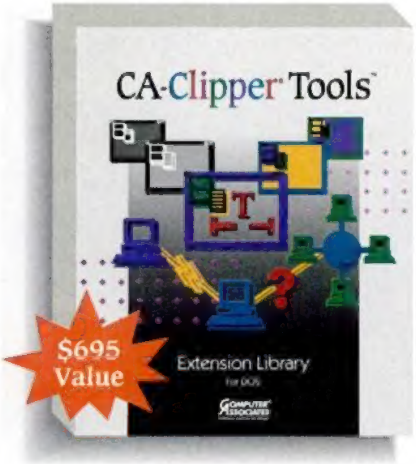

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Inside

All right! No more hype! No more speculation! No more vituperation! Windows NT is finally *real* and we have *real* test results. Windows NT has probably been the most talked about nonproduct the computer industry has seen in a long time. For a product that has mostly been an idea in the minds of Microsoft, NT has been dissected and bisected relentlessly.

Microsoft's dominant role in computer software—and its ability to generate publicity—is only one reason for the noise level. The world is finally ready for a 32-bit multitasking, multithreaded operating system with robust networking capabilities. The shift to the 486 as the baseline PC and the increasing connectiveness of PC users raises the ante on operating systems. We got by with DOS on 286s and 386s, but the level of hardware power available on our desks demands a better OS.

You've had a number of choices for 32-bit operating systems, notably the many flavors of Unix and, more recently, IBM's OS/2. But a lot of people waited to see what Microsoft would do; they'd be foolish to ignore the biggest player in the game when choosing their software.

"NT: See How It Runs," should answer most of your questions about how well NT works. We've looked at various beta versions of NT ("The Power Under the Hood," June 15, 1993), but we really couldn't tackle the nitty-gritty issues of performance until we had "gold code"—Microsoft-speak for the shipping version of the OS.

The team—led by executive editor Robin Raskin, Technical Director (Software) Rick Ayre and PC Labs Technical Analyst Amarendra Singh—tackled NT from all angles: for the user on a workstation to the network administrator who wants to know whether to trust mission-critical SQL applications to the new OS. How will it run existing apps? How will it run 32-bit apps? Is it better than Unix or OS/2? Is it scalable? Is it an application server? Now that Windows NT is real, we can finally give you the answers.—*Joel Dreyfuss*

NT On Deadline: Raskin, Ayre and Singh.

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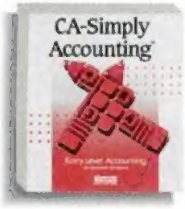

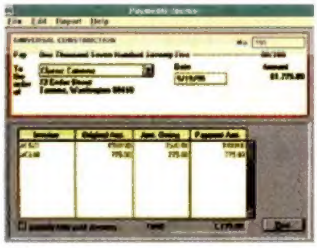

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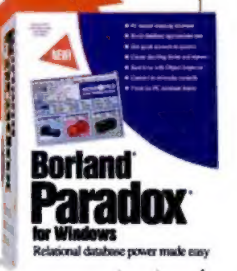

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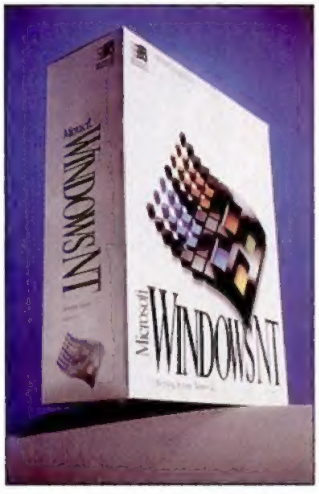

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These days, spreadsheetlike products must be able to handle data in all forms and dimensions (page 183).

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HardBall III, from Accolade, takes you out to the ball game at any of eight accurately rendered stadiums (page 442).

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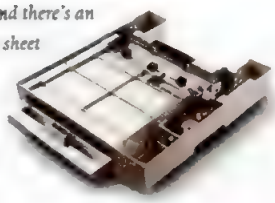

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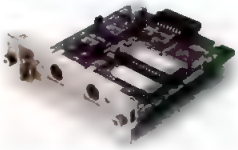

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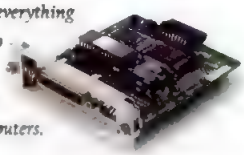

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Except where noted: All *PC Magazine* reviews are of currently available products. Benchmark and performance tests are run on Compaq Deskpro 386/25s and 25e's.

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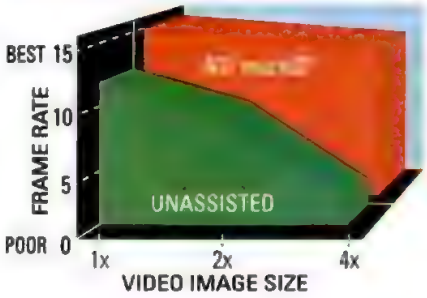

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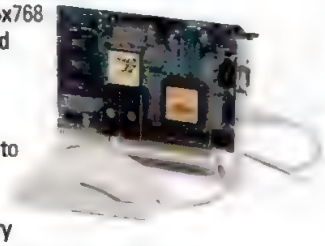

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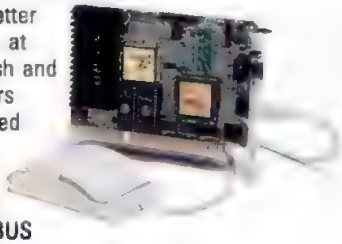

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Two w
make a

If patience is a virtue, it would be tough to find anyone more virtuous than a 386 user.

Of course, you're not waiting to be canonized. You just want to get your spreadsheet crunched, printed and e-mailed before your boss's boss calls you looking for it.

Now if you had a 486, you wouldn't have this problem. But all that wishful thinking goes out the window when you consider the double-knots on your company's purse strings.

Performance Benchmarks

(figures indicate relative performance)	Intel i386	Cyrix 486 Upgrade
MS Excel 3.0	1.0x	2.1x
MS Word 2.0	1.0x	2.8x
Micrografx Designer 3.1	1.0x	2.6x

Benchmark tests run on IBM PS/2 Model 70/20MHz

The new Cyrix 386-to-486 Upgrade Microprocessor delivers application performance that's twice as fast. And that's twice as smart.

Fortunately, there's a smarter alternative to the downward migration path pictured above. It's called the 386-to-486 Upgrade Microprocessor.™ And it's only available from Cyrix,® the smarter microprocessor company.

It's smarter because it's the only single-chip upgrade solution of its kind. And as such, the most cost-conscious way to replace the pedestrian 386 computer you have, with the searing 486 power you want.

Our upgrade chip acts just like a 486, and with good reason. It has Clock Doubling, a 1K on-chip cache

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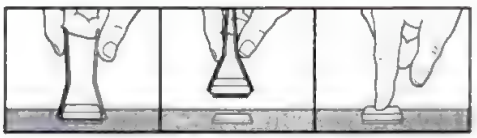
ays to 386 fly.

and enhanced Cx486 technology. Which means it delivers *twice* the application performance, and 100 percent compatibility with all your software. Like DOS, Windows and OS/2. Even Windows NT. It's also certified software compatible in Novell, Banyan and Lan Manager nodes.

MICROSOFT WINDOWS COMPATIBLE

yes It runs with NetWare

What's more, it's easy to install (it takes all of 15 minutes), and costs under $400. So it's also easy to justify to even the stingiest bean counters.



Talk about immediate gratification. Just use the chip removal tool provided to pull out your 386DX chip (16, 20, and 25 MHz versions only at the moment), and plug our Cyrix Upgrade Microprocessor into the empty socket. Then get ready for screaming 486 power.

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The more electronic equipment you work with, the greater the concern. That's why some monitor manufacturers offer models with VLMF (Very Low Magnetic Field) features. And charge extra for them.

But not Samtron. We were among the first to offer VLMF on our monitors. And now we build it into every advanced monitor.

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It's a difference even Magoo can appreciate. Take our new flat-screen 15" color monitor (SC-528DXL), for example. Together with a fine-grained 0.28 dot pitch and 1,024 x 768 high resolution, it gives you a picture that is not only steady, but crisp and clean.

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As we said, they all come with VLMF. Plus something else worth looking for.

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New two year warranty applies to products purchased after July 1, 1993

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Letters

TRUTH ABOUT PIMS, LOTUS AGENDA

Michael Miller was right in his August 1993 column, "The Right Tool for the Job," when he said of PIMs that "if you've got to change the way you work to do things the way the program demands, then you've got the wrong PIM." He was wrong, however, in giving short shrift to DOS-based Lotus Agenda 2.0, which, he said, is essentially out of circulation.

Agenda remains the only PIM that lets you enter any kind of text data at any time and redefine relationships to fit the data, not redefine the data to fit relationships of a rigid structure. Agenda is available through TigerSoftware (800-888-4437) for just $79, and it keeps selling out. Mark Twain put it best when he said, "The reports of my death are greatly exaggerated."

Craig Jennings
Chairman, Agenda Special Interest Group
New York, New York

MICROSOFT MONOPOLY

John C. Dvorak's August column, "Will Windows Turn Proprietary?" is flawed in its logic. I believe he's correct in his hunch that Microsoft is determined to make Windows a proprietary operating system, but the conclusion to draw from that is not to invest in Microsoft applications but rather to invest in those that conform to an open system. As it is, Microsoft has been forcing application upgrades on people every time it upgrades Windows. A system like OS/2 will run current applications now and in the future. Giving in to Microsoft now means being held hostage later.

Michael Class
Chicago, Illinois

Regarding Dvorak's August column, if he thinks that Microsoft's domination of the market by controlling the Windows API will spell doom for all other software manufacturers, then he's forgotten about DR DOS, OS/2, Unix, and others.

Clarence Shimek
Richmond, Texas

The Right Tool for the Job

"The reports of my death are greatly exaggerated."
—Mark Twain.

GIVE THIS MAN A PENTIUM!

Thank you Bill Machrone for shining the light of truth and sanity on the cutting-edge performance and advantages of the Pentium ("The Pentium Panic," July 1993). Nothing but the best! I want my Pentium, too! The gossip columnists of Silicon Valley spend their time ankle-biting Intel instead of praising that company for giving us technological leadership. To get the Intel quality that I got with my 486, I'd gladly pay $15,000. Money isn't everything. Nothing beats the best. The best always pays off in the long run!

Daniel J. Myers
Honolulu, Hawaii

A POOR FIRST IMPRESSION

In the review of our products QA Plus and QAPlus/WIN in your July 1993 story "Taming Your IRQs," several statements were made that left the impression that our products were lacking in capability and usability. Although the focus of the story was on system information reporting, little mention was made of our extensive set of tests for every major component, including CD-ROM drives. Many other programs don't provide critical information and leave the user with an incomplete set of data for troubleshooting problems.

Elliott Lowe
Vice President of Marketing, DiagSoft
Scotts Valley, California

• Editing changes may have inadvertently left readers with the impression that DiagSoft's products produced inaccurate information. In fact, DiagSoft's products were accurate, but their feature sets were not as rich as those of other products. In addition, QA Plus *does* provide addresses for devices that occupy commonly used I/O port addresses.—Ed.

THE PERFECT PC

Congratulations on another great "Perfect PC" issue (July 1993), but I wish you'd included information on the noise a hard disk makes. In my experience, hard disks vary greatly in the sound they produce. Sound is an ergonomic issue often overlooked in hardware reviews.

John Craven
Tallahassee, Florida

Your "Perfect PC" issue was excellent. As a consultant working with client/server systems, I've been recommending that all my clients buy a copy. I'd like to point out another consideration when choosing system components. If people are interested in running beta software, they should probably stick with Adaptec controllers for SCSI. When OS/2 2.0 was released, these were the only SCSI controllers supported. The same was true for early Windows NT and OS/2 2.1 betas. The same situation exists with Super VGA cards, and I've found that Tseng ET4000-based boards are the safest bet.

Steven Frankel
Santa Clara, California

THE PERFECT BUS: MCA VS. EISA

I was disappointed by the negative treatment of Micro Channel architecture in the "Perfect PC" issue. You say that MCA is "nothing more than a marketing footnote," and that "the practical decision leads towards the EISA bus." Need I remind you of the June 29, 1993, issue

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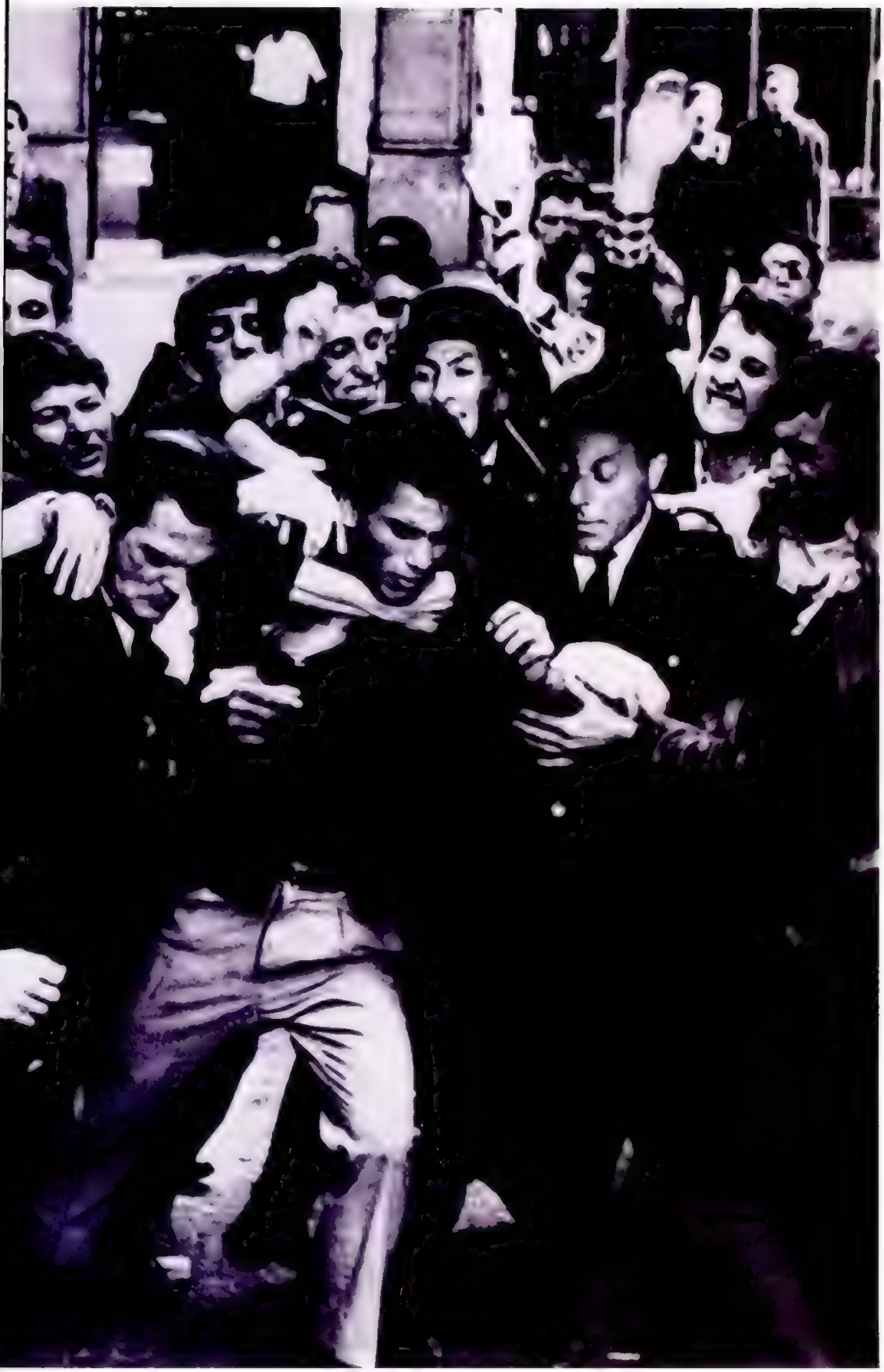

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LETTERS

covering Pentium PCs, in which the IBM PS/2 Server 95 led the way? And with state-of-the-art MCA adapter cards like LANStreamer, EtherStreamer, and SCSI-2 Wide/Fast designed with true 40-megabyte-per-second burst speed, MCA is way beyond the capability of EISA.

Stephen James Martin
Raleigh, North Carolina

MATHEMATICIANS AND THEIR SOFTWARE

I'd like to comment on your July First Look at Maple V, particularly where you say that for large symbolic calculations, users will want Maple or Mathematica, but not Macsyma. In my opinion, Macsyma is complete, capable, and clearly the most reliable. The latest release runs faster than previous versions and has adequate graphics support. My experience is that Macsyma is the choice for large and complicated symbolic calculations.

W.J. Lentz
Marina, California

UART, OR NOT UART?

I'm disappointed in your recent presentation of information about modems ("Life in the Fast Lane," June 29, 1993). You waver on the importance of the 16550 UART, sometimes saying it is mandatory while at other times failing to even mention it. As more and more users go to multitasking systems, 16550 *is* mandatory. Even if a modem is internal, a UART or emulator is still necessary.

Michael Wexler
Carrboro, North Carolina

NORMALIZING DATABASES

In your May 11, 1993, review of relational databases, "New Blood, New Power," you state that the normalization process can't be automated and that it requires an experienced database administrator. That's not actually true. Database engineers all over the world have been using our Canonizer product for over three years to completely automate normalization of their database designs.

Wayne Painter
Six Sigma CASE Inc.
Bellevue, Washington

SURPRISE! YOU NEED MS-DOS!

After reading your review of Microsoft Visual C++ (First Looks, May 11, 1993), I decided to purchase the professional upgrade to Microsoft C/C++ 7.0. I hated the fact that the C/C++ 7.0 required 386MAX in order to develop Windows programs from Windows, and your review seemed to indicate that Visual C++ had made the transition to the Windows platform.

I was shocked when, during installation, I received a message that said Visual C++ required MS-DOS 5.0 or higher and that installation was being aborted. I use DR DOS 6.0, and every other Windows program I have runs under Windows with DR DOS. I'm sending my Visual C++ back to the company and buying Borland's C++ compiler, which will run under Windows regardless of the operating system.

Robert Patrick
Tulsa, Oklahoma

"My 10 minutes of PC time has expired, and I see an EPA monitoring car cruising outside."

HISTORY REPEATS ITSELF

Forty years ago there was a story going around about the IBM Selectric repairman who "fixed" the well-endowed secretary's typewriter by raising her chair two inches. Now John C. Dvorak is telling the tale in his June 29 column, "Crazy Mistakes, 1993 Edition," about a woman with a voluptuous bosom who finds garbage on her monitor when she leans in to read the screen. I'm very surprised that the Women's PC Users Association (WPCUA) is standing mute for this recycled, albeit modernized, joke.

Norman A. Cukras
Sebring, Florida

WE THINK HE'S KIDDING, BUT YOU NEVER KNOW

Congratulations on your stand on the environment ("The Green Machine," May 25, 1993). By all means, make people aware! In our corner of the world, we have a strong Environmental Protective Agency (EPA) that has regulatory powers. Anyone wishing to upgrade needs a permit, and all PCs must be painted green within five years. If you want to get rid of your PC, you can trade it in to the EPA for 100,000 rand or an AK47 rifle with 100 rounds of smokeless ammunition. I must go now because my allocated 10 minutes of PC time has expired, and I see an EPA monitoring car cruising outside.

Arnold Kalk
Bedford Park, South Africa

CORRECTIONS AND AMPLIFICATIONS

Follow-up testing on Hercules Computer Technology's Graphite VL and Dynamite VL video boards (First Looks, August 1993) shows that the Graphite board does, in fact, work in harmony with UltraStor's 34F SCSI VL-Bus adapter. Additionally, contrary to our findings, the Graphite's refresh rates surpass those of the Dynamite.

In the July 1993 New & Improved section, the fax number for obtaining sales information for David Berman Developments' TimeWise for DOS was incorrect. The correct fax number is 206-671-7698. If you would like to contact David Berman Developments directly, it can be reached at 613-565-7311; fax, 613-235-7067.

In the July Service & Reliability survey, Dell Computer Corp.'s score of 8.5 for Satisfaction with Repair Excellence was significantly above average. The chart on page 298 has an incorrect bar for Dell's score in that category.

HOW TO WRITE TO PC MAGAZINE

We welcome your comments and suggestions. Please send correspondence to Letters, *PC Magazine*, One Park Ave., New York, NY 10016-5802, or upload it to PC MagNet (see page 12 for access information). All letters become the property of *PC Magazine* and are subject to editing.

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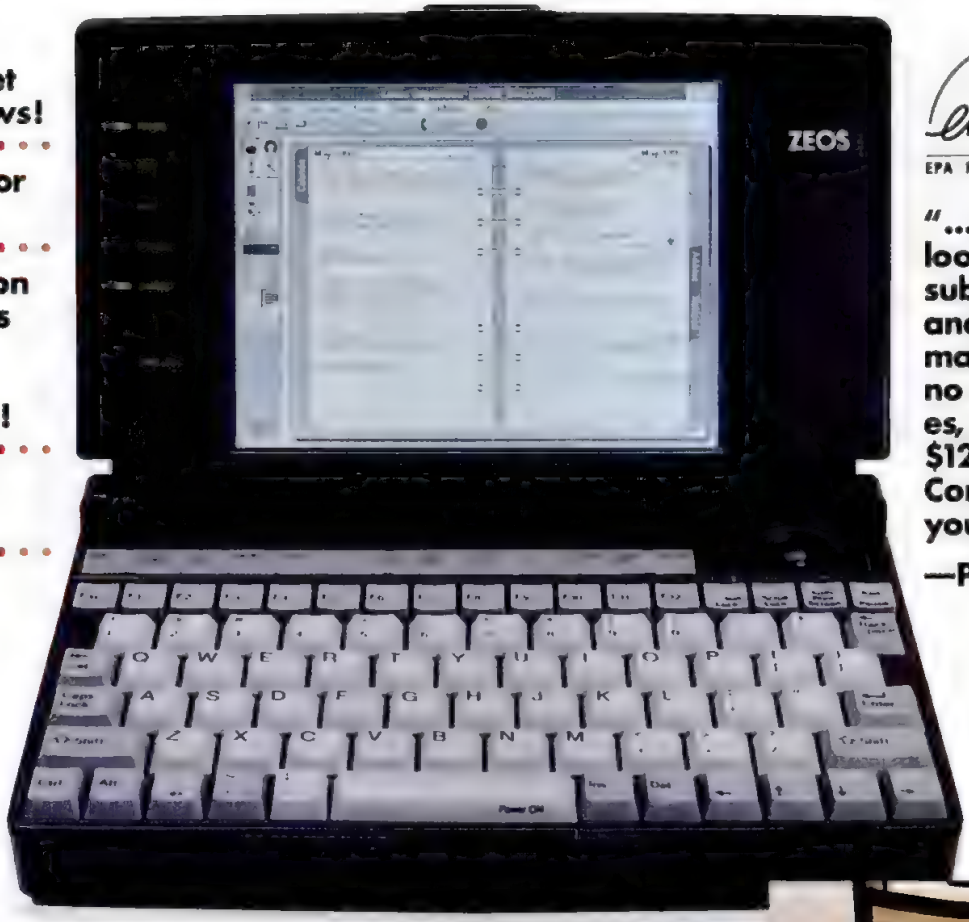

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—PC Week

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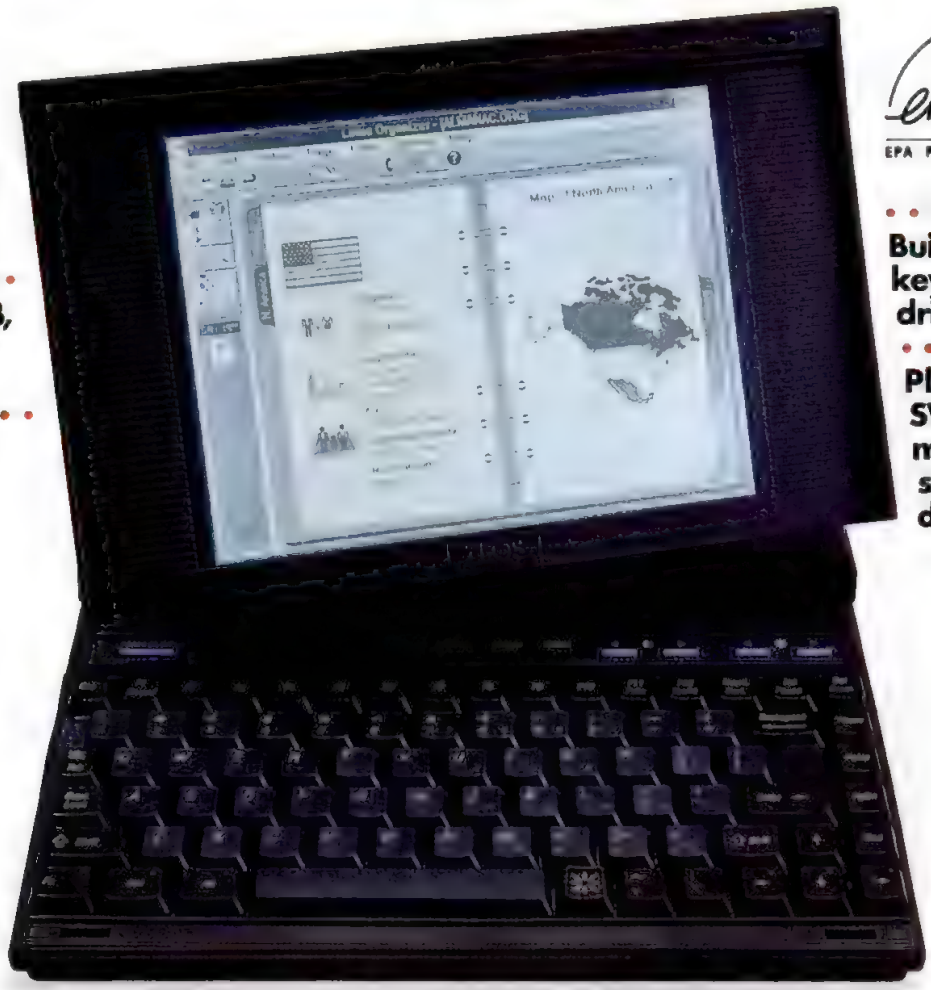

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What do our customers want in a notebook? Not only great looks, you said, but also great power. Lightweight too, like five pounds and change. And with built-in accessories that make it the ultimate in portable power.

The ZEOS Freestyle is the direct result of discussions with our customers. For the most power, now you can choose from either a 386SL or 486SL Intel processor. We've included such features as a built-in mouse key, floppy drive and soft carrying handle. And at only 5.6 pounds, you'll want to take it with you whenever you travel!

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- MS-DOS 6.0
- Microsoft Windows 3.1

486SL Freestyle: $2495
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- 180MB IDE hard drive
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- Custom nylon carrying case
- Extra battery
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- MS-DOS 6.0
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CIRCLE 334 ON READER SERVICE CARD

Try Before You Buy

Software samplers coming on CD-ROM

When Corel Corp. shipped CorelDRAW 3.0 on CD-ROM last year, the advantages of distributing software applications on CD-ROM disks became clear. For developers, choosing CD-ROM over floppy disks increases storage capacity and lowers cost of goods—a factor that's becoming increasingly important in these days of shrinking margins. For end users, the new distribution technology also means a powerful new tool for choosing among applications: the sampler CD-ROM disk. Now you can try out scores of applications before deciding which ones to buy. The first sampler CD-ROM disks offered mere demos, but the newer ones provide full-blown applications. To prevent you from pirating the software, they may be date-stamped to self-destruct, or crippled (can't store or can't print, for example). Once you decide to buy, you just call up the developer (or the seller of the disk) and exchange your credit card number for an unencryption key that automatically installs the application on your hard disk and registers you as a user. A shrink-wrapped version, or maybe just the manual, arrives a few days later.

TestDrive Corp., a Santa Clara, California–based startup, evangelized the concept of try-before-you-buy CD-ROMs earlier this year (800-788-8055). The company soon expects to ship the TestDrive Super Store, a $9.95 CD-ROM disk with approximately 50 applications, including programs from Borland, Broderbund, Caere Corp., and WordPerfect Corp.

The power of try-before-you-buy samplers has not been lost on some of the industry's biggest players. Apple has been distributing an apps demo disk with its Performas since they were introduced last fall. The company is currently talking to developers about expanding this approach to selling and distributing applications, and expects to make announcements later this year.

Ingram-Micro, the world's largest wholesale distributor of PC products, will soon distribute CD-Access to its resellers. The free disk will contain 100 to 200 demonstrations and encrypted applications.

Most recently, IBM got into the act. The IBM Software Manufacturing Co.'s CD Showcase is designed to let users test, purchase, and install applications without leaving their desktops.—*Mary Kathleen Flynn*

Illustrations by Ad McCauley

Big PC Shakeout

IT HAPPENED IN AUTOMOBILES, IT happened in typewriters. Now the PC industry is quickly beginning to shake out, as companies such as Everex and CompuAdd struggle to survive and companies such as Zenith Data Systems and Packard Bell pool their resources to combat the competition. The increasingly fierce price cutting—especially by name-brand companies Apple, Compaq, IBM, and the like—is putting tremendous pressure on the second- and third-tier manufacturers.

Today there are hundreds of companies selling PCs. To request products for our PC roundups, *PC Magazine* routinely contacts 125 companies that market nationally. By all accounts, that number will be smaller in a few years. How small—and how fast the industry will shrink—remain subjects for conjecture.

"Over the next 18 months," predicts Jacques Clay, general manager of Hewlett-Packard's Grenoble PC division, "the few hundred manufacturers we have today will be down to 25." Furthermore, says Clay, "five of them will capture 60 percent of the market." That would be a bigger piece of the pie than the top 10 companies enjoy today. Last year, those companies accounted for 42 percent of the PCs sold worldwide, according to Dataquest, a market researcher.

Other industry executives think along the same lines as HP's Clay. "Over the next two years," predicts Scott Cutler, vice president of Chips and Technologies, "ten companies will take over 80 percent of the market."

"Even fewer," insists Dell CEO Michael Dell, who puts the total number of survivors at about five. It's no surprise that he expects Dell will be one of them.

With all this fallout, is there any room left for the smaller companies? Mike Zabaneh, a co-founder of Tangent Computer, says smaller companies need to act "less like manufacturers and more like super VARs. We have to offer more features, the latest technology, and we have to vertically integrate our products to focus on niche markets." But, says Zabaneh, the price war can't go on forever. "Even the big guys can't keep it up."—*Mary Kathleen Flynn*

Pipeline *By Robin Raskin*

Can dBASE Save dDay?

With plummeting stock prices and a history of prematurely announced products and missed ship dates, Borland International could sure use a winner. Wouldn't it be poetic justice if dBASE, the very product that financially overextended the company in the first place, turned out to be the product that put things back on an upward swing? It's a possibility, but it's not going to be easy.

The problem is not Borland's products. Paradox for Windows and Quattro Pro for Windows are both *PC Magazine* Editors' Choices. dBASE for Windows, due sometime around the first of the year, looks, in previews anyway, like another great product. Marketing it could be a Sisyphean task.

The product's survival depends on wooing Xbase programmers over to an object-oriented way of thinking without asking them to sacrifice any of their traditional dBASE techniques. While dBASE for Windows is rich in features, it may be too late to appeal to the 4 million dBASE developers who have reached a midlife crisis in their code.

Borland began planning the Windows version as a dBASE compiler only; the plan was scrapped when Borland realized that developers wanted a full programming environment. A fresh start—incorporating the speedy Arago technology acquired from WordTech—created a very ambitious product with a fully integrated enironment.

In theory, users should follow a progression to the new environment. dBASE for Windows is 100 percent compatible with dBASE III and IV. It uses the familiar "catalog" metaphor and familiar dBASE constructs. To create a window box, you type DEFINE WINDOW. From here, you can continue procedurally à la dBASE for DOS, or treat the new window as an object, assigning its properties through the property inspector. Those who make the full OOP leap will be able to subclass these objects, and thus use full inheritance and encapsulation.

There's a visual-interactive forms designer, too. Workgroup elements from Borland's OBEX technology, plus the shared database engine and drivers with Paradox, give dBASE for Windows enough muscle for the client-server environment.

dBASE users will confront a big product with lots of room for growth. But it's like kids looking at their parents' clothing and wondering if those "big clothes" will ever fit...or even whether they want them to fit. It's not clear whether dBASE developers want to create full-blown object-oriented apps or whether they simply want to put a Windows front end on their existing apps. And my programmer buddies tell me that Xbase is already a fairly kludgy language, before tacking OOPS extensions on it.

Two years ago, when Borland bought Ashton-Tate, it acquired incredible market share. To continue to leverage the advantage of that purchase, Borland needs to convert dBASE programmers to Windows programmers. This winter we'll find out if Borland bought into the past or the future.

Robin Raskin is an executive editor of PC Magazine.

The Age of the Appliance

IF A NOVICE ASKS WHICH COMPUTER is easiest to learn and operate, you probably suggest an Apple Macintosh. But that won't be the case for long if Microsoft, Intel, and PC manufacturers like Compaq have their way. In developing a Plug-and-Play ISA specification, the industry is finding ways to create PCs that are as easy to use as a television.

Plug-and-play has two connotations. On one level, it's the ability to take a computer out of its box, plug it into the wall, flip a switch, and start working. On a second, more complex level, plug-and-play is the ability to add components to an existing system without spending hours resolving DMA and IRQ conflicts, switching jumpers, or changing I/O addresses.

The Plug-and-Play ISA specification will certainly play a role in the latter definition: The PC, peripherals, I/O devices, operating system, and drivers will work together to eliminate conflicts. Further down this road to the age of the appliance, BIOSes will automatically detect and configure the plug-and-play devices.

It's too early to see some of the results of the new standards, however. "To really do it right, you need an operating system that's fully aware of plug and play components," says Carl Stork, Microsoft's director of Windows platform definition. The next release of Windows (now known as Chicago) will incorporate many of these plug-and-play features; meanwhile, says Stork, "companies can test cards to make sure they work together, and write utilities to make them easier to install."

Compaq Computer Corp. has taken the initiative to heart, though its new mass-market line, Presario, is plug-and-play only in the sense that it's designed for first-time users who want an easy-to-use, integrated unit. The real plug-and-play features, based on the new ISA specification, will not be available until the middle of 1994.

The Presario line features an integrated CPU and monitor, preinstalled software geared toward home users, and automatic power-down mechanisms that allow the units meet the EPA's Energy Star guidelines. The new systems sell for $1,100 to $1,300, and are available in the same mass-market channel as the IBM PS/1.

"To us, plug-and-play refers to the overall experience the customer has in selecting, buying, and getting the systems working for day-to-day use," says Judy Alam, product manager for Compaq's software marketing division. "Configuration of new components is the most difficult issue, but the overall goal is to make the customer experience a comfortable one."

—*Julie Cohen*

GUI Commercials, GUI Movies

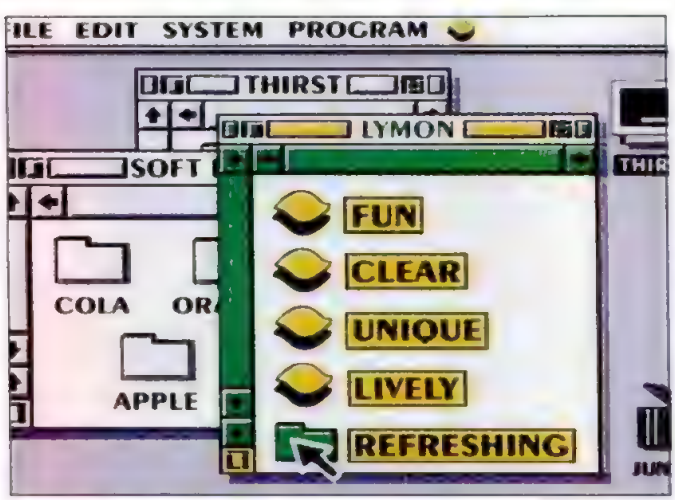
MADISON AVENUE, THAT BAROMEter of U.S. popular culture, has just served notice that the graphical user interface has made it into the mainstream.

Major makers of consumer goods, such as Chrysler (Dodge automobiles) and Coca-Cola (Sprite), have adopted GUI screens for use in mass-market television advertisements. "We wanted the ads for Sprite to be user friendly, and visually interactive, says Bob Bertini, a spokesperson for Coca-Cola USA. "Our target consumer is 12 to 29 years old and part of a generation that grew up with computers. This ad was a fun way of reaching them."

In the Sprite commercial, a skittering mouse makes its way through a series of Windows-like dialog boxes that ultimately leads to the choice of Sprite. It looks just like Windows, except when the can of Sprite explodes through the screen.

The fact that GUI now has such wide appeal comes as no surprise to the GUI fans at Microsoft. "Our market research from the last 12 months shows that graphical is the preferred interface. And the number of people using Windows is of mass market proportion," says Gary Gigot, Microsoft vice president of marketing.

Even Hollywood seems to be jumping on the graphics bandwagon. Nearly a decade ago, the credits for *The Terminator* featured the command line's cursor. Even in last year's *Sneakers*, Robert Redford wore his fingers to the bone hacking to save U.S. Government secrets. Yet in this summer's *The Firm*, Tom Cruise can be seen pointing and clicking when he has to do some research in the law library. (Note, though, that when he clicks on "Print to LaserWriter," the sound of a dot-matrix printer is clearly audible.) Even Madonna's gotten into the act. In her recent video called Rain, there's a shot of four women typing away at their keyboards and doing some piecharting in a Japanese Windows spreadsheet. Just goes to show: here today, GUI tomorrow.—*Sandra Donnelly*



TV ads—like this one for Sprite—music videos, and movies are going GUI.

When Will Real-Time Video Arrive?

THE PROMISED EXPLOSION OF movies that run on your PC has been a bust so far, because of a lack of hardware and software to make it happen. Apple's QuickTime has set the standard and most computer-based movie development is happening on Macintoshes. Meanwhile, Microsoft's Video for Windows has been languishing.

Inexpensive video-capture hardware that lets you pull and digitize images from video cameras is just beginning to proliferate, but one blind spot of Video for Windows has been the lack of editing tools to create digital video applications. That changed recently, when Adobe Systems and ATI Technologies began shipping movie-making tools.

Adobe's Premiere, Version 1.0, and ATI's MediaMerge are both $295 Windows products that use a storyboard metaphor to construct time-code–based movies. Using video that has been digitized by a capture board, or using video stored on CD-ROMs, you edit frame by frame, adding transitions from one clip to another. Both of these products let you interleave audio tracks with the video segments to produce customized clips, and both let you work with QuickTime for Windows files.

Although the MediaMerge software is ATI's first foray into the imaging software scene, the company has many years' experience in the video adapter business and is one of the largest video card vendors in the world.

Adobe is no stranger to digital video or image editing. A Macintosh version of Premiere has been available for more than two years, and Adobe sells Illustrator and PhotoShop image-editing products for both the Macintosh and the PC.

Premiere for Windows won't have the complete functionality of the shipping Macintosh version, at least for the time being. Adobe says it expects Premiere to be used by consumers for editing home videos, as well as by corporations that may want to begin experimenting with using video clips for their presentations and training.—*Christopher Barr*

Top Retail Software

Current ranking	Last issue	Product/ company
1	--	**Microsoft Windows 3.1** *Microsoft Corp.*
2	--	**QEMM 7.01** *Quarterdeck Office Systems*
3	4	**Access for Windows 1.1 Upgrade Kit** *Microsoft Corp.*
4	5	**OS/2 2.1 Upgrade Kit** *IBM Corp.*
5	2	**WordPerfect 6.0 for DOS Upgrade Kit** *WordPerfect Corp.*
6	--	**Quicken 2.0 for Windows** *Intuit*
7	7	**WordPerfect 5.2 for Windows** *WordPerfect Corp.*
8	11	**WinFax PRO 3.0** *Delrina Technology*
9	14	**Paradox for Windows 1.0** *Borland International*
10	3	**MS-DOS 6.0 Upgrade Kit** *Microsoft Corp.*
11	--	**Money for Windows 2.0** *Microsoft Corp.*
12	13	**Procomm Plus 2.01** *Datastorm Technologies*
13	1	**Lotus 1-2-3, Release 4 for Windows Upgrade Kit** *Lotus Development Corp.*
14	--	**pcAnywhere 4.5** *Symantec Corp.*
15	--	**Quicken 6.0** *Intuit*

This list ranks PC business programs according to the total number of copies shipped to stores and resellers in the week ending July 24, 1993. The list is based on shipments to more than 12,000 retail locations. It does not include sales made directly by software publishers and cannot be interpreted as a picture of the entire software market. Sales information compiled by Ingram-Micro.

Exercise Your Mind

IF TECHNOLOGY IS GOOD FOR JUST one thing, then it should be for improving our quality of life. And what could be better for you than a little exercise? So goes the thinking behind the HeartBeat Personal Trainer from HeartBeat Corp. (203-328-3003), which uses a video game to take the boredom out of your exercise regime and throw a little challenge into the monotony.

Using a Sega-based game deck that hooks into a TV and either a stationary bike or a stairclimber, HeartBeat's Personal Trainer comes with a sensor that attaches to your ear to monitor your heart rate. An optical speed sensor measures the pace of your pedaling or stepping. Control pads that have navigation and fire buttons attach to the handles of your exercise equipment. It is able to store the exercise history of four users. After you've programmed the base rate, the game will slow down or speed up to help you maintain a predetermined heart rate. And, of course, help you win the game.

HeartBeat's first two games, which will be available in late 1993, are typical of shoot-'em-up arcade games, but titles planned for shipment later in the year will be more sports- and adventure-oriented. While these *are* games, they're not for kids. They are intended for serious exercisers who need a little distraction to relieve the tedium—*Christopher Barr*

Multimedia Tools For Teaching

EDUCATORS ARE FINALLY LOOKing at personal computers in imaginative ways. Software companies, textbook publishers, and teachers are joining forces to develop interactive multimedia learning software that'll make you wish you were back in the fifth grade.

Until now, computers in the classroom have served more as expensive flashcards than as "Knowledge Machines," a point made by MIT professor of education and mathematician Seymour Papert in his new book, *The Children's Machine, Rethinking School in the Age of Computers* (Basic Books, 1993). He argues that teachers must play a critical role in bringing productive technology into the classroom, a theme that's making its way into reality.

Preparing teachers to be receptive to multimedia technology is what multimedia software developer Macromedia (415-252-2000) and leading educational publisher Prentice Hall (a divison of Paramount Communications) are hoping to achieve in their Authorware Academic project. Using a special, inexpensive version of Authorware Professional, a cross-platform multimedia authoring tool, teachers are able to create their own interactive courseware, complete with sound, animation, video clips, graphics, and text. Predesigned templates provide the overall structure of the application as well as a *perpetual navigation system* with buttons and menus to which, say, a chemistry teacher can write an interactive tutorial and add video clips of what students have to do in the lab.

Students are learning with new multimedia tools.

By supporting the the digital video file formats QuickTime (Mac and Windows) and Microsoft Video for Windows, Authorware Academic serves as a front-end to video disk players and PC/VCRs. The package will be available in the late fall and will cost between $99 and $149.

This initiative is laying the groundwork for a whole cadre of multimedia authors in various academic disciplines to become a source of curriculum-based multimedia programs for teachers, says Kevin Howat, director of business development at Macromedia. Other projects are also underway. In Honolulu, Computer Visualizations (808-539-3669)—which is part of the University of Hawaii's High-Tech Incubation Facility—is developing a multimedia imprint with MacMillan McGraw-Hill. In a joint development with NASA, the company is creating NASA's Revealed Treasures: Viewing America from Above, an interactive CD-ROM application that uses sound, video, stills, and text to teach the uses of remote imaging and remote sensing. And in Mission to Mars, a week-long classroom role-playing activity, the students do everything from designing space suits to running space simulations. All of these programs are expected to be released in January 1994 at a cost of $40 per disk. —*Carol Levin*

Briefs

HOW SCHOOLS USE SOFTWARE IS GETTING a lot of attention lately from the software industry—and from Congress. The Software Publishers Association has published Education Software Management, a $35 kit to help educators (202-452-1600, ext. 341). Meanwhile, Senators Kennedy, Harkin, and Cochran have proposed the Technology for Education Act for 1993, which has won qualified support from the Business Software Alliance. The BSA is urging Congress to eliminate its insistence on national software standards.

SOFTWARE MAKES HISTORY. THE SMITH-sonian Institution has opened the National Software Collection at the National Museum of American History in Washington, D.C. The collection will preserve historically significant programs. Microsoft Word was the first product to be inducted.

THE PCMCIA SLOT, WITH ITS TINY PERIPH-erals, enables smaller PCs. Now, a new part from LSI Logic will let supporting it on the system board take up less space. The HT27 integrates core logic, power management, and the PCMCIA controller all on one chip.

IF YOUR FINGERS HAVE TROUBLE FINDING the function keys, try Ergonomixx's new MyKey keyboard, which lays out the function keys like a clock to help you remember their location (703-771-1047).

TO HELP PC USERS GO GLOBAL, KNOWLEDGE Computing, the U.K.-based publisher, is selling The Multilingual PC Directory, a guide to foreign language software. (Write: 9 Ashdown Dr., Borehamwood, Herts., WD6 4LZ, U.K., or contact CompuServe account 72240,3447.)
—*Mary Kathleen Flynn and Carol Levin*

SO ADVANCED IT EVEN TURNS ITSELF OFF.

PC MAGAZINE EDITORS' CHOICE

March 16, 1993
FlexScan F340iW

1993 W 100 WINDOWS MAGAZINE ANNUAL WIN AWARD

FlexScan F550i

Nanao, the technical leader in monitors has done it again. In addition to being the top choice of today's CAD/CAM, DTP and Windows users, Nanao's award-winning FlexScan monitors now have a remarkable energy-saving system — PowerManager.

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*The Energy Star emblem does not represent EPA endorsement of any product or service.

PC MAGAZINE MVP WINNER

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WINDOWS MAGAZINE 1993 W RECOMMENDED

FlexScan F550iW

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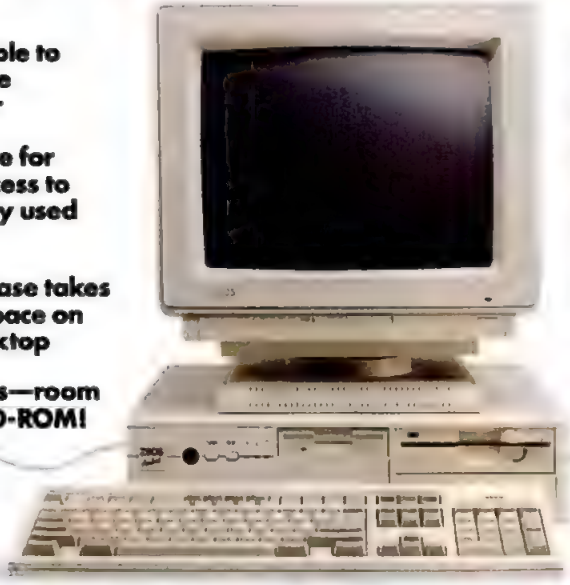

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–PC World, August 1993

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First Looks

HANDS-ON EVALUATIONS OF THE NEWEST SHIPPING PRODUCTS

■ **Personal Information Management**

PackRat 5.0: Bugs Hurt Major Update

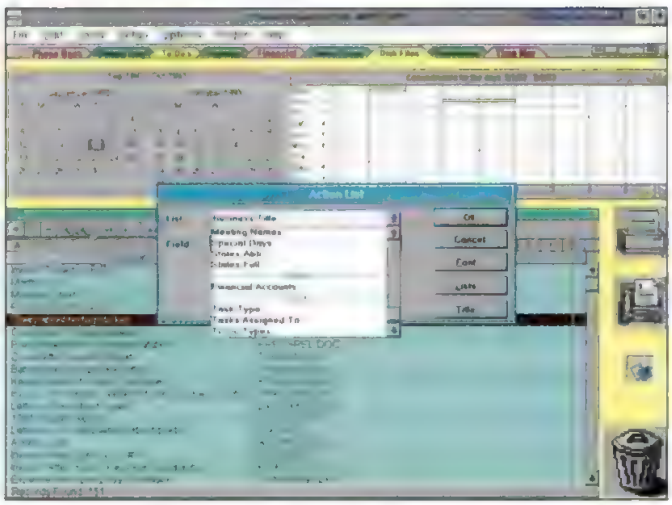
BY BARRY SIMON

Polaris Software's PackRat has the reputation of being the most powerful and flexible personal information manager, but it's also hard to learn and has historically tended to have bugs in major upgrades. PackRat 5.0 ($395) lives up to this reputation.

The Windows-based PackRat is nothing less than a PIM construction set with a basic structure that will thrill those who rely heavily on organized personal information. But the program is so plagued with bugs and design flaws that it seems more like a program that's still in development than a release that's ready for prime time.

NEW INTERFACE

The redesigned desktop metaphor uses on-screen folders with tabs along the top for navigation. You might have one folder for your schedule, for example, and another for your phone book. The objects you place in the folders can be different views of your PIM data, such as a phone book list or a weekly view of appointments.



IMMEDIATE ACTION: *A mouse click adds action lists to a folder.*

PackRat's expanded scope of features make it a wide-ranging PIM. It comes with a variety of customizable folder setups for legal, medical, and other professions, to which you can deposit a wealth of objects, including Clock, Calendar, Day View, Month View, Gantt Chart, Application Icon, Printer and Fax Buttons (for drag-and-drop), To-do List, Need-to-Contact List, Action Button, Document Manager, Financial

Continues on page 38

■ **A New Look for a Subnotebook**

Dauphin's Modular DTR-1: Portable, But No Desktop PC

BY JULIE COHEN

Dauphin Technology calls its new DTR-1 a true desktop replacement. You're likely to ooh and ahh when you first see this 2.5-pound subnotebook, which is among the smallest, lightest, computers available. But you're not likely to be inspired to throw away your powerful, capacious desktop system just yet.

Powered by a a 25-MHz Cyrix CX486SLC processor, the Dauphin DTR-1 is a lightweight subnotebook that converts to a pen computer. It's lighter than any other PC-compatible machine on the market, and its backlit screen is easier to read than most reflective varieties.

OOH, AHH: *Dauphin's modular subnotebook.*

But don't get rid of your desktop PC just yet. The Cyrix processor, with its 1K internal cache, is fast enough for many applications but not as speedy as an Intel 486DX. Furthermore, the DTR-1 can hold only 6MB of RAM; its internal hard disk holds 40MB worth of data (80MB with DOS 6.0's DoubleSpace activated). The black-and-white VGA display is quite small, and typing will be uncomfortable for almost anyone with hands larger than a ten-year-old's.

That said, the DTR-1 has plenty in its favor as a traveling machine. For one thing, its modular configuration (separate display, keyboard, and floppy disk drive) lets you decide how much or how little you want to carry. With the CPU and 1.3-inch Kittyhawk hard disk hidden in the display module of the DTR-1, that unit

Continues on page 39

IN FIRST LOOKS

IBM PC DOS 6.1 39
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Photography by Thom O'Conner

PackRat

CONTINUED FROM PAGE 37

Journal, Time Manager, and Spell-Checker.

PackRat 5.0's new SmartStart installation automatically provides a starter set of folders geared towards a type of profession that you specify during setup, such as accounting, government, or legal. This lets you jump into using PackRat right away. You can use these predefined workspaces as they have been created, or you can customize them to fit your own unique needs. The new PackRat also has a set of Instant Options, which gives you the ability to hit the right mouse button and customize the software's object-oriented tools.

At the heart of all its enhanced customizability is PackRatBASIC, a full-featured programming language for designing macros and assigning them to buttons for automating routine operations.

PackRat 5.0 supports any electronic mail package that conforms to the Messaging Application Programming Interface (MAPI) or Vendor-Independent Messaging (VIM) standards. It also imports and exports data to and from dBASE, Paradox, and Btrieve, as well as to and from the Sharp Wizard and other personal digital assistants.

APPLICATION INTEGRATION

One of the major enhancements in PackRat 5.0 is the ability to integrate PIM information more directly with your Windows applications. Why would you want to have a Windows app embedded in a folder in your PIM? Because such a setup lets you drag and drop a contact name onto your Microsoft Word for Windows document, for example, and have the name, address, and salutation entered automatically. You could open an application window outside of PackRat, but having the letter at your fingertips is more convenient.

Some of the important applications that PackRat 5.0 currently integrates with are Ami Pro, Microsoft Excel, WinFax PRO, Word for Windows, WordPerfect for Windows, and a variety of e-mail packages such as cc:Mail and Microsoft Mail.

This flexible construction-set approach extends to reporting. You can create reports by adding objects that you can customize with the right mouse button. Customizable template reports are provided, or you can build your own.

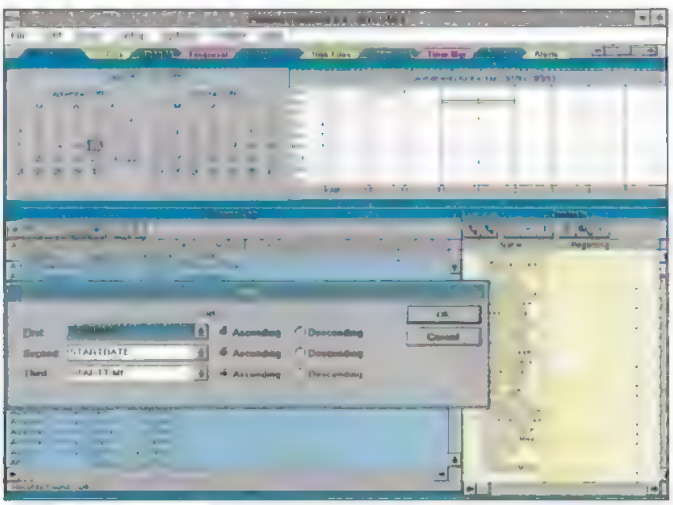
Polaris thinks of the newest version of PackRat as a two-fold productivity tool. On the one hand, like it always has, version 5.0 organizes a vast wealth of important information, from your calendars and contacts to your finances and projects. On the other hand, with all its new integration capabilities, the new PackRat acts as a software manager, streamlining your Windows desktop and allowing you to perform most of your computing chores from within PackRat itself.

FIRST LOOKS PLUS

From September 13 through September 17, you can go on-line to download a demo of PackRat 5.0 or to discuss the program with Barry Simon and Polaris president Jack Leach. Type GO ZNT:EXEC from any CompuServe prompt.

THE BAD NEWS

So much for the good news. The bugs we encountered in testing ranged from a few General Protection Faults to text over-writing buttons on certain data-entry forms. Sometimes we got a General Protection Fault when PackRat was loaded and we tried printing from WordPerfect for Windows. Both WordPerfect and Polaris are working on a fix.



PRIORITIZE: *Quickly sort a list of tasks from the object menu.*

Occasionally, buttons didn't work on forms for unexplained reasons. And the program insists on starting every file dialog in the Windows directory rather than the PackRat directory. We were unable to get the Word for Windows integration macros to install automatically, and after we installed them by hand, the macros didn't work properly. As far as reporting goes, the month-at-a-glance report printed out with two weekday columns truncated.

There are substantial speed problems and file-size issues as well. A PackRat 4.1 data file containing about 2,000 items swelled from 800K to 2.4MB after conversion. There's also an increase in program files from 1.2MB to over 8MB.

PackRat 4.1 loaded in about 10 seconds, but 5.0 takes almost a minute. To display the phone directory after a restricted search takes 2 seconds under 4.1 and 10 seconds under 5.0. These speeds were annoying but acceptable on a 66-MHz 486 with a 700-item phone directory. With a much larger directory or a slower machine, they might not be tolerable.

There are also some severe design flaws. The worst is that almost all input forms are modal. That is, when they're open, you're prevented from accessing the rest of the program. In PackRat 4.1, it was annoying that while recording a phone call you couldn't access your previous phone log, but at least you could access your appointments and Rolodex. With PackRat 5.0, you can't access any of the PIM data, which makes the program severely limited for contact management.

WAIT AND SEE

Many of the components promised in the product and documentation are not yet ready. For example, there's supposed to be a time-and-billing macro that uses the billing-rate information you enter in the Rolodex. Additionally, the on-line help and documentation are woefully incomplete and inaccurate in many places.

For now, your best bet is to stick with Version 4.1. Past history and current promises from Polaris suggest that the bugs will be ironed out, which is an exciting prospect. Like with other versions of PackRat, there will probably be several incarnations of Version 5.0. The fix that *PC Magazine* tested was already version 5.01c. For now the best recommendation is to wait.

• List price: *PackRat, Version 5.01c, $395; upgrade, $99.* Requires: *2MB RAM (4MB recommended), 8MB hard disk space, Microsoft Windows 3.1. Polaris Software Inc., 17150 Via Del Campo, #307, San Diego, CA 92127; 800-722-5728, 619-592-7400; fax, 619-592-7430.*

Circle 428 on reader service card

Dauphin

CONTINUED FROM PAGE 37

can serve as a pen computer.

There are also some features we'd love to see on all standard portable computers. Most notably, the AC power adapter is smaller than a pack of cigarettes and weighs less than 8 ounces—a real boon to portability. In fact, the whole package is remarkably lightweight. As a pen unit, the DTR-1 measures 9 by 5 by 1.5 inches and weighs less than 2.5 pounds; add the keyboard, carrying case, and AC adapter and you're up to 4.2 pounds.

The complement of ports and peripherals gives travelers everything they need in terms of hardware. A built-in modem transmits faxes at 9,600 bps and data at 2,400 bps. Internal Ethernet support is available, but it must be specified at the time of purchase and it adds $299 to the price. To add network support later, you'll have to return the DTR-1 to Dauphin.

The DTR-1 also has some characteristics that have proven to be serious drawbacks to most subnotebooks. The screen measures only 6 inches diagonally and the 9-inch Chiclet keyboard falls about 2 inches short of the 11 inches needed to make touch-typists happy.

Dauphin makes the DTR-1 usable as a pen computer by providing Microsoft Windows for Pen Computing and one pen-centric application—a reduced version of PenCell, from PenWare Inc., designed especially for Dauphin.

The system's ability to recognize handwriting is limited by Windows itself. Unless, therefore, you have a custom-designed application—typically forms-related—you'll probably find little compelling reason to use the DTR-1's pen capability.

What's still missing from the DTR-1 is PCMCIA support. Dauphin expects to ship a version with a Type III PCMCIA slot later this year. This addition should help address the problem of limited storage space.

SLUGGISH PERFORMANCE

When compared to other Cyrix 486SLC-based notebook computers, the Dauphin DTR-1 held its own in PC Magazine Labs' processor and memory tests. The DOS video score was better than average, but the disk score was unusually low.

Battery life also proved somewhat problematic, since the system ran out of steam after just 1 hour 25 minutes. Dauphin has addressed this issue by offering an optional battery pack, which attaches to the display and should extend the life of the unit to about 8 hours when it becomes available.

If you consider low weight and high versatility your main criteria for portable computing, the DTR-1 will suit many of your needs. But use it in conjunction with, not as a replacement for, your desktop PC.

• List price: *Dauphin DTR-1 with 4MB RAM, 40MB hard disk, internal fax/data modem, DOS 6.0, Microsoft Windows 3.1, Windows for Pen Computing, mini-keyboard, leather traveling case, $2,695. External floppy disk drive, $199; Internal Ethernet adapter, $299. Dauphin Technology Inc., 377 E. Butterfield Rd., #900, Lombard, IL 60148; 800-782-7922, 708-971-3400; fax, 708-971-8443.*

Circle 433 on reader service card

■ **Operating Systems**

IBM's PC DOS 6.1: Has MS-DOS Met Its Match?

BY EDWARD MENDELSON

Welcome to the DOS battleground, where IBM's PC DOS 6.1 ($189) is now taking on Microsoft's MS-DOS 6.0. IBM's DOS builds on the code of MS-DOS and generally improves on it, although IBM's DOS has some new utilities that may cause installation problems on some specific systems.

The standard DOS commands and programming functions in IBM's version are identical to those in Microsoft's, although IBM optimized its version of the DOS kernel for faster character input/output and batch file processing on 386 and 486 systems. In PC Labs' tests, IBM DOS 6.1 processed batch files just slightly faster than MS-DOS 6.0.

The main differences between IBM DOS and MS-DOS are the different utilities and the additional hardware support built into IBM's version. IBM supplies the complete Central Point Backup for DOS and Windows and uses Central Point's RAM boost for upper-memory optimization. Instead of licensing a third-party antivirus program, IBM included a DOS and Windows program originally written by IBM for its large corporate accounts.

CHECK UP: *IBM's own antivirus software.*

The PenDOS program, for systems with a stylus and tablet, lets you use the stylus as a mouse replacement, for writing DOS commands, or for entering data into applications. PCMCIA functions offer DOS and Windows support for fax, modem, memory, and hard disk cards.

IBM's version of SuperStor compression wasn't ready in time for testing by PC Labs, but IBM claims that it will have the same level of integration with DOS supplied by DoubleSpace.

IBM's treatment of systems that have PC Tools for Windows installed is poor. If you choose the option that installs DOS's copy of Central Point Backup for Windows, the installation program comments out the reference to PC Tools' original WNUSER.INI in WIN.INI and replaces it with a reference to a WNUSER.INI in a subdirectory of C:\DOS. Until you restore the original reference, none of your PC Tools applications can find the files they need to load.

IBM DOS 6.1 doesn't end the battle of the DOSes. Novell has announced that Novell's DOS 7, the successor to DR DOS 6, will include built-in multitasking (not just task-switching) and support for the DOS Protected Mode Interface (DPMI) that lets built-in utilities run in extended memory instead of upper memory blocks.

Meanwhile, IBM's DOS 6.1 surpasses Microsoft's DOS 6.0 just slightly in performance and more tangibly in features. If you're upgrading from DOS 5.0, IBM's DOS is the better bargain, but unless you need the enhanced compression or pen and PCMCIA support in IBM's DOS, there's little point in upgrading from MS-DOS 6.0.

• List price: *PC DOS 6.1, $189 ($59.95 through October 26); upgrade $109.* Requires: *512K RAM, 3MB hard disk space. IBM Personal Software Products Division, Old Orchard Rd., Armonk, NY 10504; 800-342-6672.*

Circle 427 on reader service card

■ Electric Mail

Lotus cc:Mail 2.0 Adds Rules-Based Messaging

BY DON WILLMOTT

Release 2.0 of Lotus Development Corp.'s cc-Mail for Windows is a great upgrade to an already good electronic mail system. Interface improvements and the addition of rules for automating many messaging tasks make the program much faster to use.

The most obvious aesthetic change is the replacement of cascading text boxes and folders with a more straightforward treelike guide. You point and click to open the message folders you need.

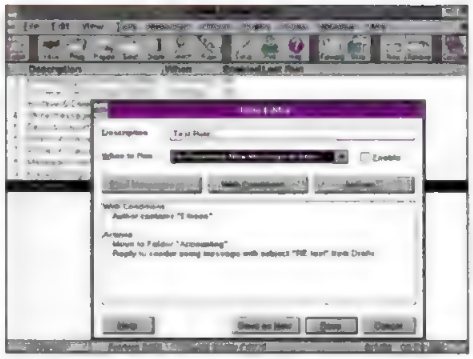
Like all other Lotus products, cc:Mail has customizable SmartIcons to help you control just about every part of the program. One of the icons activates cc:Mail's new spell-checker, part of an improved text editor that also has a search-and-replace function.

The new Rules features let you set up complex, automated mail routing and actions with plain-English ease. For example, by setting up a rule, you can have all incoming messages from John Smith or messages with the header "Invoice" delivered to your Urgent folder. Then you can send a boilerplate reply to John Smith automatically, and forward a copy of the "Invoice" message to five other people. Rules can be time-sensitive, too, so that all messages received between 9:00 A.M. and 10:00 A.M. can be stored in a certain place or be responded to in a certain way.

Also new to this version is a search tool that can look for text strings across all your mail folders, and a spreadsheet viewer.

The main problem with the new version is minor but annoying. In order to maintain compatibility with the DOS version, cc:Mail only gives you access to five unattractive fixed-space fonts. Not only that, but because DOS compatibility requires an 80-character line, messages don't wrap within the text window.

Users of the DOS version of cc:Mail who have been reluctant to switch over to the Windows version in the past because of concerns about speed should take a look at 2.0. The well-designed interface and the rules-based messaging are compelling reasons to upgrade.



NEW RULES: *Set up complex actions with ease.*

• List price: *cc:Mail for Windows, Release 2.0: $495 for one post office. Upgrade, $195; 10-user pack, $345; 25-user pack, $845; 100-user pack, $3,295.* Requires: *2MB RAM, 2MB hard disk space, Microsoft Windows 3.1. Lotus Development Corp., 55 Cambridge Pkwy., Cambridge, MA 01242; 617-577-8500.*

Circle 431 on reader service card

■ File Server

Affordable Compaq ProSignia 5/60 Harnesses Pentium's Power

BY RICK AYRE

Compaq's ProSignia 5/60 combines the forward-thinking design of Compaq's new uniprocessor TriFlex architecture with a 60-MHz Intel Pentium processor in a reasonably priced package: less than $6,700 for a fully configured system.

The ProSignia is the low end of Compaq's server line. It's TriFlex/PC Architecture is a uniprocessor version of the SystemPro's TriFlex/Systems Architecture. This architecture features a 128-bit memory bus, a 64-bit processor bus, and a 32-bit EISA I/O bus.

One result of such optimization is excellent throughput. In tests performed by ZD Labs using NetBench 2.06 that compared Pentium-based servers from IBM, Hewlett-Packard, and NEC with the ProSignia, the ProSignia had the best or second-best data throughput when 32 or fewer clients were loaded on a network. Throughput for all four systems dropped sharply when handling 36 or more clients.

A base configuration, with 16MB of RAM and a 550MB hard disk, Fast-SCSI-2 controller, and a monitor sells for about $6,689, and Compaq offers a wide range of hard disks and controllers for custom configurations. Given its price, the ProSignia's performance is impressive.

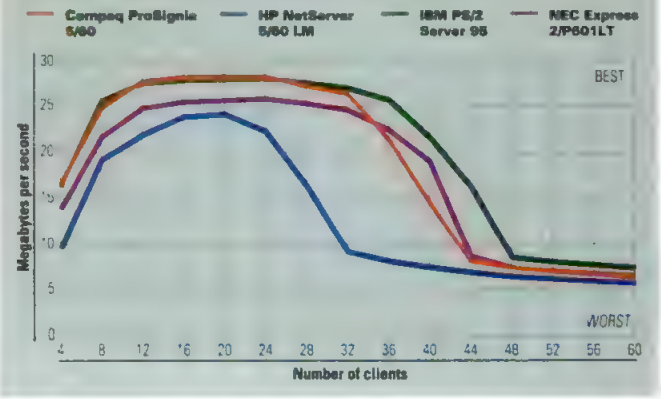
• List price (tested configuration): *Compaq ProSignia 5/60 with 32MB RAM, 2.2GB disk array, 32-bit NetFlex network interface controller, QVision 1024E card and 1,024-by-768 monitor, $11,939. Compaq Computer Corp., P.O. Box 692000, Houston, TX 77269-2000; 800-345-1518, 713-370-0670; customer service fax, 713-378-1442.*

Circle 432 on reader service card

ZD Labs Benchmark Tests: Compaq ProSignia 5/60

The Compaq ProSignia 5/60 occupies a high position in the server class. Though the ProSignia's throughput peaked at 20 clients, the system was either first or a close second in data throughput with a load of 32 clients or fewer. With more than 32 clients, performance dropped sharply, but the ProSignia still compared favorably with the IBM, NEC, and HP servers.

Using the **Random Read/Write** test from NetBench 2.06, with a 1MB file and a 4K block size, ZD Labs measured I/O throughput on the Compaq ProSignia 5/60. This test is designed to tax the disk subsystem and thus reflects real-world stresses that a network server faces. We used a 4-client workstation load and added 4 clients at a time until we reached 60

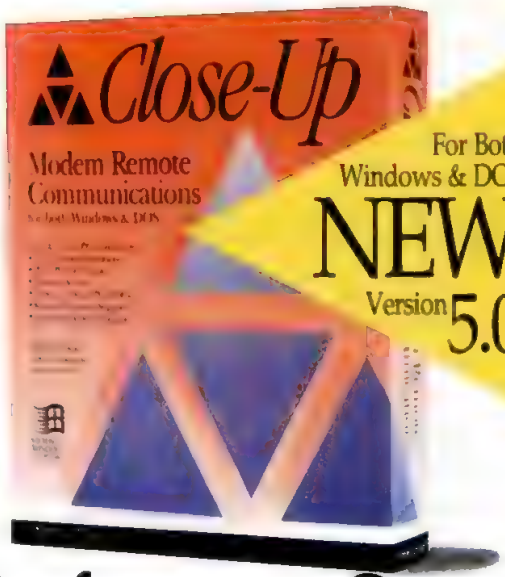


WinBench™ 3.11 by Ziff-Davis Labs Tests Remote Windows™ Speed

This graph shows the speed of the three leading remote control programs when transferring Windows screens. As you can see, Close-Up handles more pixels, faster, meaning you spend less time waiting for Windows screens.

The industry standard test, WinBench 3.11, is perfect for testing the speed of remotes. It is an accurate measure of video throughput. Video throughput is the limiting factor in remote operations, because remote programs must transmit Windows video functions from one PC to the other.

WinBench scores (average of 10 runs):
Close-Up 1,613,118
pcAnywhere 194,093
CarbonCopy 168,397



New Remote Software Sets Windows Speed Record

Communicate Faster & Easier

Close-Up® lets you communicate faster & easier with five exciting technology firsts.

Close-Up is the only remote communications software that won both PC Magazine's coveted "Editors Choice" and PC World's "Best Buy" awards. Now Close-Up has a new faster & easier version that allows you to view and control another PC by modem as if you were there!

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1. *AI Video Compression*
2. *Photographic Memory*
3. *Non-Intrusive Technology*
4. *Expert System*
5. *Video Translation*

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Close-Up learns as it works. It uses AI (Artificial Intelligence) to compress all Windows video function calls. That's why Close-Up does so well in Windows Benchmark tests (see WinBench 3.11 chart).

Close-Up uses its revolutionary Photographic Memory™ so that once Close-Up has seen all or part of a Windows screen, it's memorized. Then as screens change, Close-Up only transmits new unmemorized data. Incredibly, with this technology ***Close-Up gets faster & faster the longer you use it.***

What Remote Companies Haven't Told You

Other remote programs permanently slow Windows and usually reduce your video resolution and depth of color, even when they are not in memory. That's because they permanently change your system.ini file. Close-Up's breakthrough Non-Intrusive Technology does not modify any of your sensitive Windows files including the system.ini. Close-Up is the only remote that when not in use, allows Windows and your PC to run at normal optimal levels.

Expert System Makes Communications Easy

You don't have to be a communications expert to get the results of one. Close-Up has an Expert System that automatically analyzes system components and configures your system for optimal speed.

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With Close-Up, dissimilar PCs can easily connect, because Close-Up senses the video capabilities of both PCs and automatically displays Windows in a video mode compatible with both sides.

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We invite you to reproduce this test. We used two identical Gateway 4DX2-66V's with 66-MHz Intel 486DX2-66 CPUs, 16 MB RAM, 256KB RAM cache, 340 MB HD, IDE controller, no hardware disk cache. Video: Local Bus ATI Ultra Pro with 2MB VRAM, 640 by 480 pixels, 16 colors, VGA.DRV dated 3/10/92. Monitor 72 Hz. MS-DOS 5.0, SMARTDRV 2 MB cache. Modems: two 14,400 baud V.32bis. WinBench 3.11 is available on ZiffNet accessible via CompuServe. Test performed without verification by Ziff. All products are shipping versions. WinBench trademark of Ziff Communications Co. Windows trademark of Microsoft Corp.

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CIRCLE 346 ON READER SERVICE CARD

■ SCSI

CorelSCSI, CorelRAID: Tools for Fast Data Delivery

BY JAMES KARNEY

Corel Systems has come out with two new high-end SCSI (Small Computer System Interface) products. CorelSCSI Pro ($495) provides sophisticated drivers and system management tools for connecting almost any type of SCSI device to both stand-alone PCs and network servers. CorelRAID ($995) can transform three or more SCSI drives into a full-fledged RAID (Redundant Array of Inexpensive Disks) storage system that will run on a NetWare server.

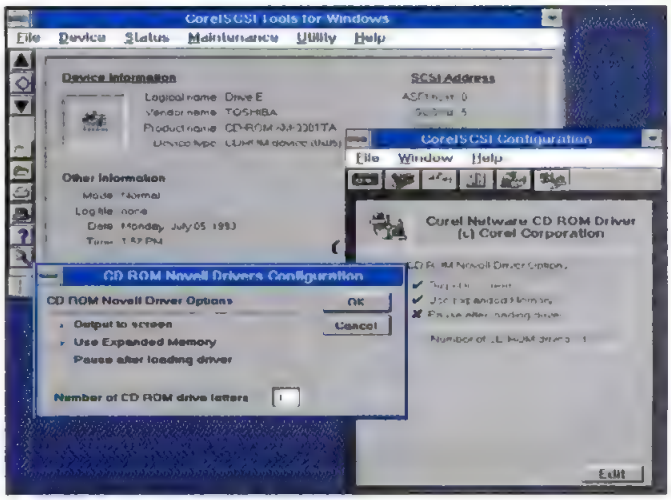
Both products work with ASPI (Advanced SCSI Programming Interface)–based host adapters and can be used with DOS, Windows, OS/2, and NetWare. CorelSCSI Pro lets you configure drivers for a wide variety of CD-ROMs, optical drives, and tape drives automatically. It also has scanner and jukebox drivers, CD-ROM caching, backup routines, and ASPI drivers for about 30 popular host adapters. You can examine and configure a variety of SCSI options with DOS or Windows utilities that are included in the package.

TESTING CORELSCSI

To see how well CorelSCSI Pro could manage a complex environment, we assembled a small network of four nodes with Windows for Workgroups running in conjunction with a NetWare server. Two of the workstations and the server had CD-ROM readers; one of the workstations was also equipped with a 1GB tape drive and an HP ScanJet IIc scanner (which was connected to an UltraStor U34F host adapter). The server was configured with a CD-ROM and a Panasonic 7010 Read/Write optical drive.

Installing CorelSCSI Pro was simple. The setup routine not only identified the devices on the SCSI bus, but also properly allowed for existing drivers for the host adapters and CD-ROM reader. The only difficulty was with the scanner. Since we were using a third-party driver, Corel's Twain interface was not available. All the other hardware on the network was up and running as soon as the installation was complete.

CorelSCSI Pro really shines when it comes to managing CD-ROMs on a network—often a major source of frustration. The reader is mapped as the next local drive on each workstation rather than as a separate network volume.



CORELSCSI: *Easy setup tools manage your SCSI devices.*

CORELRAID

RAID systems offer enhanced performance and better data reliability than single large volume disks. That's the advantage. The drawback is price. RAID subsystems start at about $6,000 and go up—way up. Most require the use of special hardware, matched SCSI disk drives, and custom drivers. CorelRAID offers an alternative. You can use any combination of SCSI drives with one or more ASPI-based host adapters.

TESTING CORELRAID

To test CorelRAID, we configured a Micronics EISA-3 motherboard with an Adaptec 1542C host adapter and three IBM/AdStaR 62 1GB SCSI-2 drives. Since the RAID software doesn't allow a DOS partition on the actual RAID drives, we set up NetWare 3.11 to boot from a floppy disk and used Corel's automated installation routine. We could have configured another hard disk (not part of the RAID) as a boot device.

The three drives were easily configured as one 2GB RAID 5 system using the Corel menu. (CorelRAID can operate as either RAID Level 4 or 5.) Level 5 lets each drive in the array store part of the parity information for the data written to all three units. Adding additional drivers would have increased the available storage area, but the entire array would still appear as a single unit. In the event of a disk failure, the remaining disks automatically restore the data in the background while they continue to provide services as if nothing is wrong.

SAFE SOFTWARE

To test the software's safety, we shut down one drive and removed it. The server continued to read and write data to four workstations and manage a print queue without a hitch using only two drives. To exercise the system, we loaded several programs and large files in a number of apps, then sent a collection of 35 bitmap images through an Eagle NPE400 printer server. Everything worked normally, and at about the same speed as a similar local SCSI-2 drive with an UltraStor U34F adapter.

The console posted a notice to the supervisor at regular intervals that a drive in the array had failed. We installed another drive, and the CorelRAID interface reported it and monitored the status of the repair. In about 40 minutes the full complement of three disks was back to normal. If we had designated another disk in the system as a hot standby disk (but not an active part of the RAID series), the software would have immediately begun the restoration process to that disk once it sensed the failure.

If you have to manage a variety of SCSI devices, or want to convert sets of drives into a very reliable mass-storage system for NetWare servers, these two products offer a relatively easy and cost-effective solution.

• List price: *CorelRAID, Version 1.0, $995; CorelSCSI Pro $495.* Requires: *CorelRAID: NetWare 3.11 server with at least three SCSI hard disks and one ASPI-compatible SCSI host adapter; CorelSCSI Pro: compatible SCSI device and ASPI-based host adapter. Corel Corp., 1600 Carling Ave., Ottawa, Ont., Canada K1Z 8R7; 800-836-7274, 613-728-8200; fax, 613-761-9176.*

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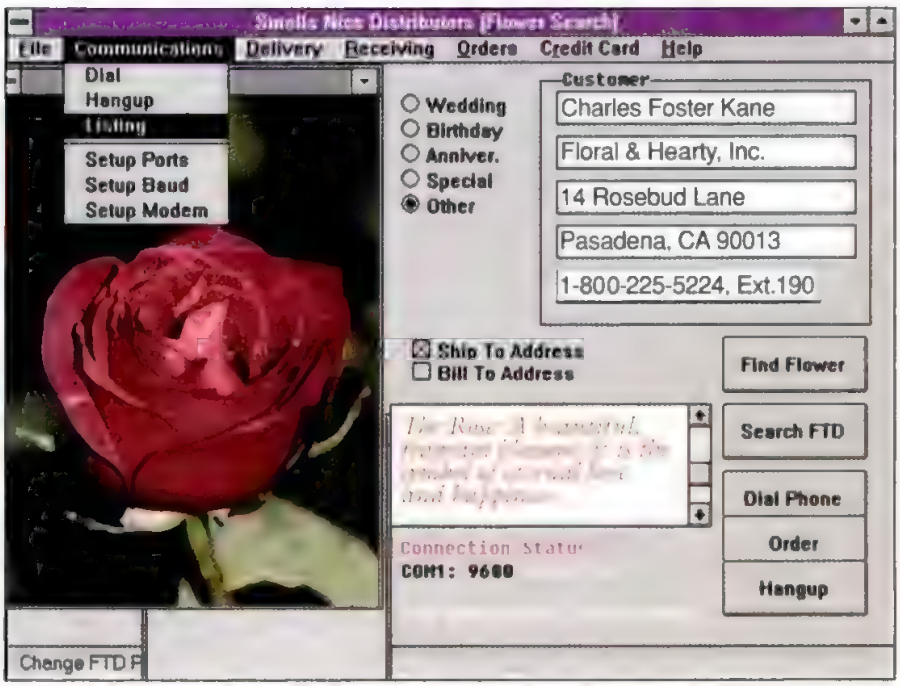
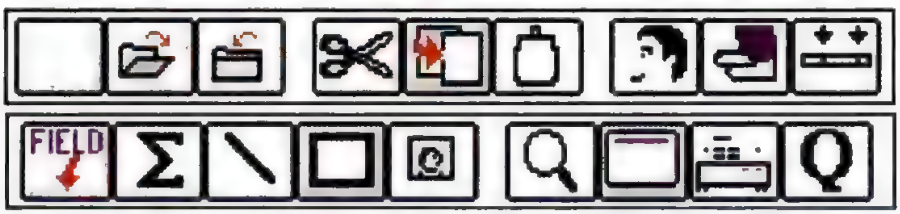


CA-dBFast includes Windows interface objects for pull-down menus, push buttons, radio buttons, check boxes, scrolling list boxes, bit-mapped graphics and more.

The Visual Application Designer (VAD) makes creating pull-down menus, push buttons, radio buttons, check boxes, scrolling list boxes and other Windows objects as easy as "point and click" or "drag and drop." The VAD generates the required source code, saving you hours of complex programming. You also get a debugger that's so advanced it lets you watch your source code execute at run time – even Single Step through execution.



CA-dBFast's report writer, CA-RET, lets you mix text, graphics and data to produce great-looking reports in minutes.

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CIRCLE 400 ON READER SERVICE CARD

■ Workgroup Computing

WordPerfect Office 4.0 Redefines E-Mail Integration

BY LANCE ULANOFF

By integrating e-mail messaging, calendaring, and personal and group scheduling, WordPerfect Office, Version 4.0, is giving e-mail a whole new meaning.

This is no patchwork quilt of features and functionality. Under both Windows and DOS, the main window paradigm is the same: All the features are right there, and there's no shelling out to other add-on packages (unless you want to).

WordPerfect Corp. has also made this a truly cross-platform product, with clients for DOS, Macintosh, OS/2, and Windows all shipping simultaneously, and all able to use the same post office and the same database off one server or off a series of servers (WordPerfect calls them "domains").

A minor misstep up front: Although the DOS client shares all the functions of its GUI counterparts, it does suffer from the limitations of its environment. The interface is boxy, and though it's somewhat customizable, you can't change it to the degree that's possible under Windows.

A NEW WINDOW

The new Windows client is a different story. The main window takes up approximately one-third of the screen and includes icons for appointments, calendaring, mail, notes, phone messages, and tasks. A major portion of the screen is occupied by an open area called the "shelf." Here, you can place icons for custom views and often-launched applications. The product also makes good use of the right mouse button to customize and/or change selections.

The upper-left-hand portion of the main screen contains icons for the in-box, out-box, and trash can. The in- and out-boxes actually serve as repositories for all types of appointments, interactions, messages, notes, and tasks. The out-box, for instance, is a great way to track the progress of messages. Double-clicking on an outgoing message reveals if and when it's been received and opened.

The mail engine has also been enhanced with a spell checker and thesaurus, as well as basic rules and routing capabilities. Rules can act as the secretary so few of us have. Whether you're away from your desk or simply don't want to handle every piece of e-mail that comes your way, rules can do the work for you—reading, moving, and even acting on e-mail as it arrives in your in-box.

These same rules can forward mail, send boilerplate responses, and save messages to specified folders (WordPerfect Office lets you create any number of user-defined folders). And although rules can be designed to act upon WordPerfect Office start-up, they can't be set to launch an application upon the receipt of a message.

Added to all that is the ability to create simple routing slips that can, say, send mail from user one to user two, and then on to user three—instead of broadcasting the message to all recipients at once. When the mail recipient opens the mail, WordPerfect Office prompts the reader with a message explaining that this message has a routing slip, and when they check "completed," the mail will automatically be sent to the next person on the list.

But network administrators should note that the routing feature requires its own dedicated server (called the Message Server). Analogous to NetWare's MHS (Message Handling Service), this is a logged-in node that handles routed and excess message traffic. Unfortunately, configuring the Message Server is not automatic in the administrator setup.

OFFICE MEETINGS

Group scheduling ties in nicely with these features. Provided you have access to other users' schedules, you can search across free and busy times for a whole group. You can also include resources in these searches.

Few features in WordPerfect Office's arsenal will prove as useful as its confusingly named Proxy ability. In a group situation, the opportunity to look at and act on another user's views (calendar, mail, and tasks) can be invaluable. Provided you have been given read privileges and/or write privileges, you can call up any number of other users' views and dynamically access them through a small icon that appears in the lower-left-hand corner of every view screen. One click, and a drop-down list of alternative user views appears.

Administrators should appreciate a rather trouble-free installation procedure and multiple gateways to MHS, SMTP (Simple Mail Transfer Protocol), and X.400. A DOS-based remote package also ships with the DOS client.

In the end, it doesn't really matter if WordPerfect Office has actually turned the definition of e-mail on its electronic head. For Windows users, at least, it manages to offer what Microsoft should have offered in Microsoft Mail and Schedule+: integrated e-mail, calendaring, and scheduling. □

FACT FILE

WordPerfect Office, Version 4.0

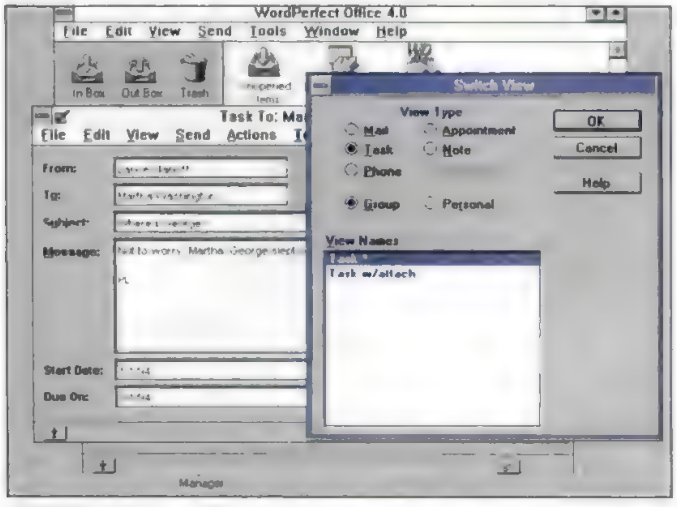
WordPerfect Corp. 1555 N. Technology Way, Orem, UT 84057; 800-451-5151, 801-222-5000; fax, 801-222-5077

List price: Administration and Server Pack for DOS or OS/2, $295 Client Pack (5 users) for DOS or Windows, $495

Requires: Server: 450K RAM, 40MB hard disk space. Client: 450K RAM, DOS 3.3 or later Windows client 4MB RAM, Windows 3.1

In short: WordPerfect Office 4.0 is most notable for the way it seamlessly integrates e-mail with group scheduling and calendaring

401 ON READER SERVICE CARD



BETTER E-MAIL: *In Office 4.0, any item view can be changed.*

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Primavera software is being used to control the construction of the new $30 million U.S. Embassy in La Paz.

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RADARSAT is a low orbit satellite that will take radar images of the earth. The engineering, design and manufacturing stages for this $300 million project are being scheduled using Primavera Project Planner® (P3®).

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P3 will be used to rebuild the Autobahn in what was formerly East Germany. Both contractors and subcontractors are standardizing on Primavera for this project.

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This $20 billion airport construction project also includes the construction of highways, an airport rail system, a suspension bridge and a cable stay bridge. Projected completion is June 1997.

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This $100 million, 420-meter tower will be the third tallest communication tower in the world. Estimated completion date is 1996.

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CIRCLE 148 ON READER SERVICE CARD

Network Communications

WINview: Remote Access with a Twist

BY BRIAN BUTLER

With WINview for Networks, Citrix Systems is pioneering a new type of server technology. WINview is an application server that lets multiple remote users simultaneously access applications written for Microsoft Windows (in Real and Standard mode), as well as DOS and OS/2 character-based applications. Windows and Windows applications live in a central location, and all PCs connected to the server have access to them. You can connect to WINview via dial-up telephone lines, across wide area networks (WANs), or directly via NetWare or LAN Manager.

Installation of WINview is straightforward (though it took us two tries to get it right). It takes approximately one hour to install the server and five clients. The clients connect to WINview's server via a small DOS program. You simply select the server that you want to connect to and the software either dials the WINview server or connects over the LAN.

LIKE LOCAL

Once the connection is established, you must log on with your WINview account. From that point forward, WINview acts and feels as if you're running applications locally, when in fact, the application is running on the server and your workstation is receiving only the compressed screen images. While performance was surprisingly quick, we did notice that mouse movements in Windows were a little sluggish.

Since WINview is a multiuser system, security is a must. To gain access to WINview, you must have a log-on ID defining what rights you have on the system. WINview supports group security, and also allows access to be controlled down to the file level. In addition, you can optionally audit the use of any system resource. All administration is done through a full-screen interface and can be handled remotely. User account administration includes restrictions on log-on hours, time, amount of virtual memory, as well as several others.

A nice feature of WINview lets you off-load time consuming tasks to the WINview server. You simply log on to the server, execute the program, and then disconnect. The program continues executing on the WINview server even after you've disconnected. Later, when you log back on, you can check the status of the program. WINview security lets the administrator control the use of this helpful feature.

DIAL-IN ACCESS

The explosion in the notebook market is making dial-in remote access more of a requirement than a luxury. We compared WINview to remote-access software and saw very little difference in performance between them. However, remote-access programs can only service one user at a time, while WINview can handle as many as 20 users. In addition, generic dial-in service provides only limited security, and it doesn't run applications in protected mode. Thus, if an application crashes, the dial-in service is down until the system is reset. Since WINview runs all applications in protected mode, system crashes become less likely.

SLOW PCS COME ALIVE

Another advantage of WINview is that it lets slow PCs run high-end applications. Since all the processing happens at the WINview server, a 286-based system with limited memory can run Windows. The same holds true for PCs incapable of running processor-intensive programs such as database apps efficiently. Move the database application to the WINview server, and several users can take advantage of a faster machine. In effect, you can turn a program like FoxPro for Windows into a quasi-client/server application.

This same concept can be applied to a file server–based database application on a WAN. Instead of transferring large amounts of data across the WAN, simply move the application closer to the data and send only the compressed screen images.

Behind the Scenes

At the heart of WINview for Networks is a high-performance, 32-bit preemptive multitasking system based on the IBM OS/2 2.0 kernel, with some of the enhancements that are now found in OS/2 2.1 also included. Two key traits of WINviewfor Networks are its support of virtual memory and protected-mode operations. Therefore, idle sessions are paged to disk, giving more physical memory to all the active sessions, and misbehaving applications can crash without affecting the system's integrity.

In addition, WINview has another important piece of infrastructure, a multitasking network subsystem that provides seamless NetWare integration, including IPX/SPX support and multiple user log-on ID's.—*BB*

FACT FILE

WINview for Networks, Version 2.0

Citrix Systems Inc., 210 University Drive, #700, Coral Springs, FL 33071; 800-437-7503, 305-755-0559; fax, 305-341-6880

List price: Five-user pack, $1,995; 10-user pack, $2,645; 20-user pack, $3,995; 5-user add-on pack, $695.

Requires: 4MB RAM (16MB recommended), 40MB hard disk space (80MB recommended), Microsoft Windows 3.1, NetWare 2.15 or later (server); DOS 3.3 or later (client).

In short: By putting applications and processing power on a server, WINview facilitates simultaneous remote access of Windows apps by any PC.

430 ON READER SERVICE CARD

FACING THREE PROBLEMS

WINview does have some drawbacks. When you're remotely connected to the WINview server, you cannot access your local drives, and in order to copy files from your local machine up to the application server, you have to use an awkward upload/-download utility. Installations of new programs have to be done at the server console. Finally, it seems that because WINview has such a wide variety of uses, it suffers from a bit of an identity crisis on what its exact purpose really is.

WINview has the potential to address three problems faced by business today: getting secure remote access, solving WAN performance problems, and allowing low-end PCs to run high-end applications. Some of these problems can be solved by migrating applications to client/server, but that requires an expensive rewrite of existing applications.

Citrix Systems is currently working together with Microsoft Corp. to deliver a version of WINview for Windows NT. That product will have the potential to provide a more scalable application server. □

■ Workgroup Computing

Commence 2.0: Groupware That Doesn't Need a LAN

BY STAN MIASTOWSKI

Today's professional seldom works alone. That's why groupware is a hot buzzword. Version 2.0 of Jensen-Jones's Commence (formerly IBM's Current) has latched onto the trend by evolving from a personal information manager (PIM) into a group information manager.

You can still use the $395 package as a standalone PIM, taking advantage of more than 50 new features and an easier-to-use interface. But Commence really shines in workgroups, where Jensen-Jones has come up with a clever way of keeping group schedules updated on PCs that aren't always connected to a network—and even on PCs that are never networked.

FACT FILE

Commence, Version 2.0

Jensen-Jones Inc., Parkway 109 Office Center, 328 Newman Springs Rd., Red Bank, NJ 07701; 800-688-7080, ext. 2139, 908-530-4666; fax, 908-530-9827

List price: Standalone client or server, $395; server and 3 users, $695; server and 10 users, $1,995; upgrade, $49.95

Requires: 3MB RAM, 6MB hard disk space, Microsoft Windows 3.0 or later. Server requires any LAN that provides a shared file system and supports Windows workstations

In short: A cutting-edge PIM that's particularly adept at managing data, resources, schedules, and projects for workgroups. Distributed database technology and Sync Link disks make it easy to keep group and personal schedules updated on PCs that are seldom (or even never) connected to the LAN

402 ON READER SERVICE CARD

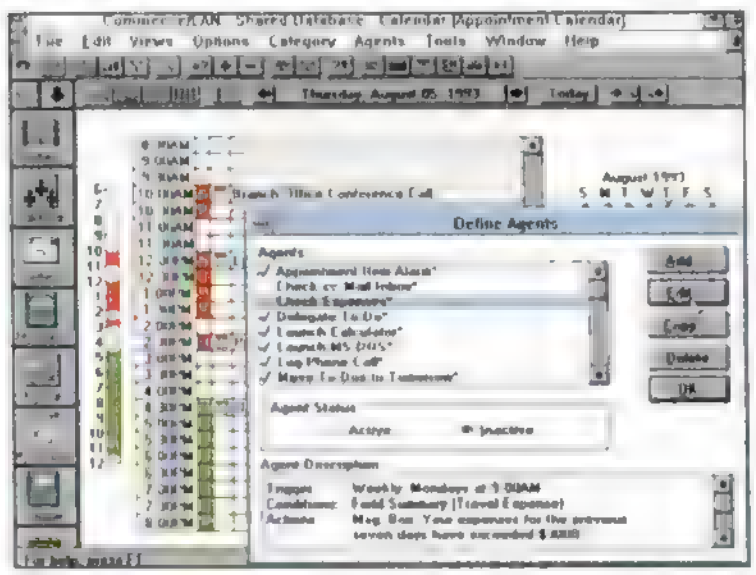
Pricing is even better for multiple copies: $695 for three users, $1,995 for ten.

The Commence server version works on any network that supports file sharing (such as LANtastic, NetWare, and Windows for Workgroups). The only limitation is that all workstations need to access the Commence server using the same drive letter. That's no problem with server-based networks like NetWare, but it's more problematical for peer-to-peer networks. We had to do some tweaking to get the Commence server to work correctly on the LANtastic 5.0 network on which we tested the software.

After installing the Commence server, each workstation needs a standalone/client version. Once everyone's up and running, Commence users can share schedules, databases, and resources (conference rooms, overhead projectors, and so on). Commence has a high degree of versatility and security. Individual users can control what personal information they want others to see, and the system administrator can control levels of access to the common database.

Like any PIM, Commence requires a commitment. You'll need to set up your schedule and import your personal database into Commence (unless you're using a common corporate database). The program easily imports data from ACT!, PackRat, and Windows' Cardfile, as well as ASCII, .DBF, and .DIF files.

The interface is much improved in Version 2.0. Common tools (calendars, letters, and so on) are represented by large icons arranged along the left side of the screen. You can click on them and start entering information immediately. There are lots of other icons, too, and you see a textual explanation at the bottom of the screen as soon as you point to them. Commence is particularly powerful at connecting various items such as appointments, companies, people, and resources. That's extended further in a workgroup situation, where you can link items such as projects or notes to particular people or resources.



AGENT INTELLIGENCE: *Commence's agents may tell you more than you need to know.*

FOR THE UNATTACHED

The problem with most group scheduling products is that they assume that all users are connected to the LAN at all times. But in the real world, that's not always the case. For example, a person who travels extensively often uses a laptop that's connected to the company LAN only when it's in the office.

Commence takes a unique approach to handling shared data. Instead of a single shared database located on the server, Commence uses a true distributed database. You keep both your local data and a copy of the shared data on your local workstation. That way, you still have access to the shared data when you're away from the LAN. The next time the system is connected to the LAN, shared data is updated on both systems automatically.

Commence also extends the distributed data concept to PCs that are never connected to the LAN. Say you want to work with Commence on your home PC in the evening. Before you leave work, you create a "Sync Link" floppy disk, which contains all updated personal and shared data. (It compresses data to take up minimal space.) At home, the Sync Link disk updates your home PC's Commence data. It works the other way, too. You can bring a Sync Link disk from your home PC to update your local and shared schedules on your office PC. It's a good approach to keeping workgroup schedules current.

Another powerful capability of Commence is its "agent" technology. Agents let you define actions that happen automatically when a "trigger" occurs. There are multiple types of triggers, including a time (create a Sync Link disk every weekday at 5 P.M., for example) or a piece of data via Dynamic Data Exchange (schedule a group meeting when sales fall below projections, for example). Agents can be simple or extremely complex. It takes some time to set them up, but it's well worth the effort.

Commence is more than your garden-variety PIM. Its advanced features, coupled with its ease of use, makes it a true time and money saver—especially for groups. We do, however, quibble with the company's support policies. Free (not toll-free) phone support is available for only 30 days. After that, it's $60 an hour. (There's also a support forum on CompuServe.) While policies of this type are becoming common, 30 days just isn't long enough to get comfortable with all the intricacies. □

■ Image Editing

Picture Publisher: Retouched for Version 4.0

BY LORI GRUNIN

Graphics novices and professionals alike will find something to love about Version 4.0 of Micrografx's $595 image editor, Picture Publisher.

Most of the changes fall into the productivity enhancement category. For instance, Picture Publisher is one of the first PC-based image-editing products to use "image object" technology. Once you've masked a piece of an image and created a copy of it, that selection becomes an independent object that retains its irregular outline. You can reorder and stack these objects over and over to control placement and revision.

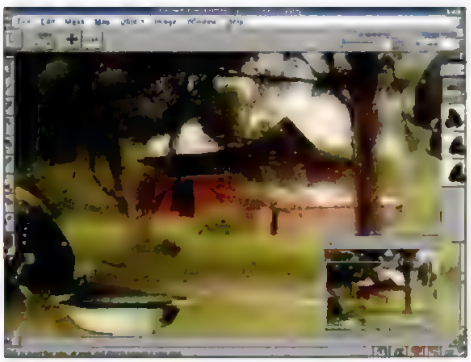
In conjunction with the new ability to paint on masks, Picture Publisher has what is possibly the most powerful and complete set of selection and masking tools on the market.

Users accustomed to working with large images will also appreciate two new File Open modes: FastBits and Low Resolution. FastBits mode lets you pick any piece of an image to work on; when you're done, the program automatically integrates that block back into the original images. This is immensely useful but has one drawback: It works only with uncompressed TIFF images, so you can't use the image-object technology at the same time.

Low Resolution mode, on the other hand, lets you open up any image at a desired resolution. Both these features can save a lot of time.

Picture Publisher not only includes more artistic special effects (such as watercolor, charcoal, and oil paint) and photographic filters (unsharp masking), but they're packaged in one dialog box that lets you preview multiple effects and fine-tune parameters on a single low-res image.

The program now boasts a greater selection of artistic brushes, such as chalk, crayon, and watercolor, but they don't begin to approach those found in Fractal Design Painter or CA-Cricket Paint.



QUICKZOOM: *A bird's-eye view for navigating.*

New Visual Contrast/-Brightness and Tone Adjustment dialogs let you choose your parameters by simply selecting the choice that looks right. This serves well for making ballpark guesses, but the thumbnails are too small for accurate judgments.

The uninspired will appreciate the 300 low-resolution stock photographic images that ship on the CD-ROM. And the multimedia-oriented will have mixed feelings about the AVI support: You can preview videos and extract frames, but it will not automatically insert the edited frame.

Despite the changes, Picture Publisher remains extremely easy to use, right down to on-line help that really does help. While you may become confused by masked elements and objects, Micrografx has packed a surprising amount of sophistication into the product without sacrificing clarity.

• List price: *Picture Publisher, Version 4.0, $595; upgrade, $149.95.* Requires: *4MB RAM (8MB recommended), 5MB hard disk space (100MB or more recommended), Microsoft Windows 3.1. Micrografx Inc., 1303 Arapaho, Richardson, TX 75081; 800-676-3110, 214-234-1769; fax, 800-994-6475.*

Circle 410 on reader service card

■ PCs

Digital MTE: Screaming Video with Room to Grow

BY BRUCE BROWN

The host of high-performance features Digital Equipment Corp. offers in its new MTE line should satisfy the demands of most users of desktop PCs and small servers for a long time. Digital's weapons against obsolence include a 32-bit EISA I/O bus, VESA local-bus video, and a PCMCIA card reader.

This mini-tower desktop line, which includes a 33-MHz 486DX model and a 66-MHz 486DX2 model, has enough drive and expansion capacity for multimedia devices. With room for 128MB of RAM—and the EISA bus's ability to address all that memory—the MTE won't run out of steam.

The compact case provides four bays for removable media drives and one internal drive bay. There are six EISA slots and one 8-bit ISA slot; one ISA and one EISA slot can also accept VESA local-bus cards.

The new PCMCIA card reader adds the potential for easy data-sharing with portable computers that use PCMCIA flash memory or hard disks. This $250 option, with two Type II slots, is one of the first to appear as an add-on for desktop machines. The reader installs in a drive bay and comes with a short interface card. A rear-access version costs $180.

Three video cards are available: two with S3 video accelerators and one using the Weitek Power9000 chip. Our $4,749 review system, equipped with the high-power Weitek card, performed superbly in video graphics mode with a Graphics Winmark score of 57.4 megapixels per second. The system's text-mode video score was low, a known trade-off of the Weitek-based card.

COMPACT BUT ROOMY: *The MTE line's mini-tower case has room for up to five drives.*

The Processor score was somewhat above average, and the Memory score was given a significant boost by the 70-nanosecond RAM and the 128K write-back cache. Disk performance, however, was relatively low.

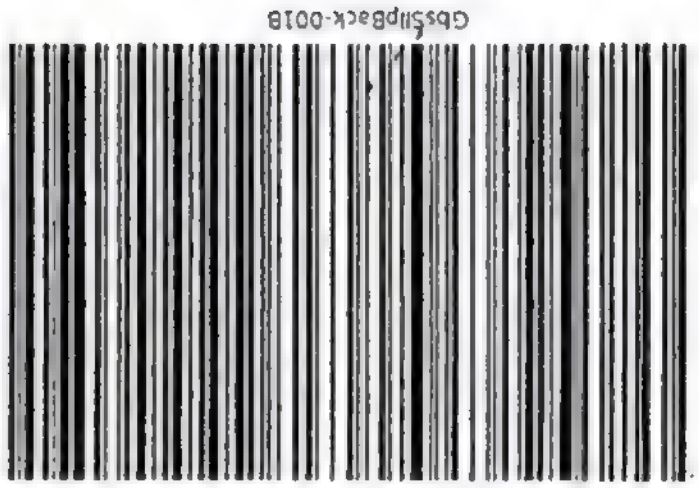
The DECpc MTE series is an attractive combination of good design, sturdy construction, fine performance, and ample expansion room. The price is high, but the value is good.

•List price: *DECpc 466d2 MTE with 8MB RAM, 128K RAM cache, 245MB hard disk, DOS 6.0, Windows 3.1, mouse $2,899. Power9000 video card, $600; 17-inch monitor, $1,000; PCMCIA card reader, $250. Digital Equipment Corp., 40 Old Bolton Rd., Stowe, MA 01775; 800-722-9332, 508-493-5111; fax, 800-524-5694.*

Circle 429 on reader service card

The Heat Is On!

Gateway 2000's summer fun ad was inspired by our stock car racing team. As you might guess, we don't spend millions on an Indy car. Ours is an all-employee team that runs on local dirt tracks. The team races pretty much the same way Gateway operates: they're competitive and successful, but they always have fun.



Inverted Back

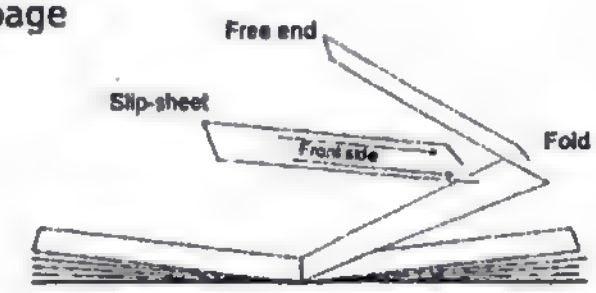
1. Follow instructions on the other side

Folded edge of the page

GbsSlipSheet-001

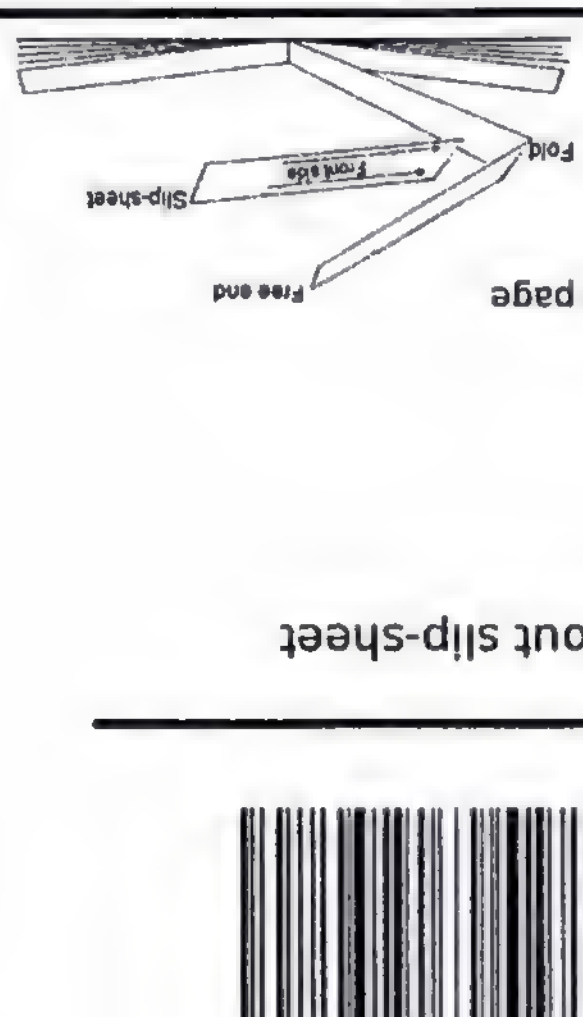
Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



Inverted Foldout slip-sheet

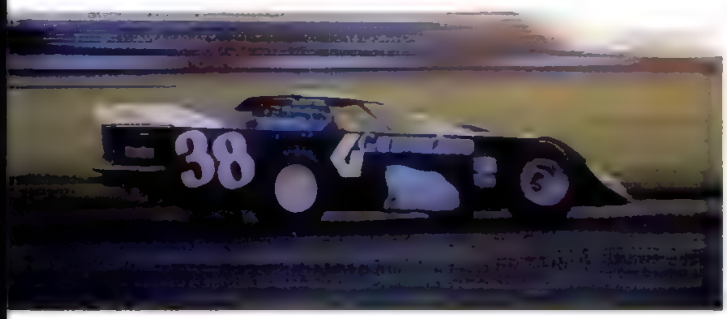
1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



But Gateway Outmaneuvers The Competition — And You Win!

In the fast-moving, hard-driving PC industry, the race for leadership is more competitive than a heat at your local stock car speedway. All classes of PC manufacturers are on the direct market track together, trading paint and slamming each other into the wall at every turn. Competitors big and small are being black-flagged and sent to the pits in record numbers this year.

All the while, season after season, the unassuming cow-spotted Gateway car consistently outmaneuvers and overpowers the competition. Repeatedly, Gateway 2000™ leads the field by providing you with the best value in the PC industry. When Gateway takes the checkered flag, you're the winner!



carefully maintained our unique, low-overhead business model with no extra parts to slow us down. The Gateway machine handles extremely well, too. We can move faster through the marketing corners without getting out of control, all of which saves you money when you buy from Gateway.

Our competitors would like to have you think they're now offering a value that meets or beats Gateway. But apples to apples, they're still hundreds, sometimes thousands of dollars more, while our systems consistently outperform theirs.

You're a smart shopper. Do the comparisons yourself and you'll confirm what Dataquest™ found in a 1993 customer satisfaction survey: Gateway ranked number one for best pricing. When you add the other buying criteria that's important to you, Gateway offers an unbeatable value.

What's The Winning Formula?

The driving strategy behind Gateway's success is simple: *understand what customers want and give it to them!*

Price

We understand you want the best possible price — and that's easy for Gateway. Like a winning stock car, we have the right combination of power, weight and handling to lead the price field.

We have the power to buy the highest quality components in huge volume at considerable savings, which we always pass on to you. Even though we're now one of the largest PC makers in the U.S. and a Fortune 500 company, we haven't let our weight get out of control (unlike some competitors). We've

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They're In Hot Pursuit Of The Value Leader...

38
GATEWAY 2000

Gateway Gives You More Horsepower.

Performance

We understand you want the best computer performance your money can buy. That's what you get with Gateway. We hold the track record in the biggest bang-for-the-buck division.

Take our 4DX2-66V system, affectionately known as the Big Kahuna, for example. In automotive terms, this system is a top fuel dragster. It has won 11 major industry awards, and they just keep coming because the 4DX2-66V includes the best of everything at a terrific price.

Another example of outstanding price and performance is our new line of ColorBook and HandBook® 486 portables. They're colorful sprint cars sure to win the upcoming notebook races! Look for them in other Gateway ads in this magazine.

That's the Gateway price-performance ratio, and it's equally good across our entire product line.

Latest-Generation Graphics

Our price-performance ratio is even better this month thanks to improved graphics on our highest performance systems. We replaced ATI's Graphics Ultra Pro, the industry's leading graphics card, with ATI's latest-generation Graphics Ultra XLR. The new XLR is up to twice as fast as the Ultra Pro, and it's the best all-around DOS and Windows™ video performer in the industry.

The ATI™ Graphics Ultra XLR is also multimedia ready, enhancing and accelerating video for Windows through hardware. When viewing motion video, you can enlarge your window size to full screen without decreasing your frame rate, getting jaggy edges, color distortion or losing audio sync.

Compatibility & Upgradeability

We understand compatibility and upgradeability are important to you. You can relax with Gateway. When Dataquest asked 833 PC users in Fortune 500 companies to rate personal computer companies, they ranked Gateway number one in the areas of compatibility, upgrade potential and price. All Gateway systems go through extensive compatibility testing to ensure flawless performance with all products from major software developers and peripherals manufacturers. And we give you a *written guarantee* that our 486 systems are upgradeable to Pentium technology. Ask us about it.

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GATEWAY2000

"You've got a friend in the business."®

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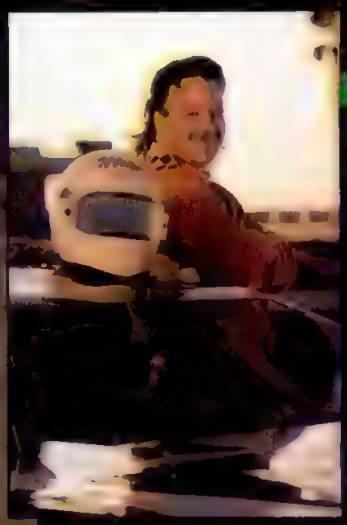
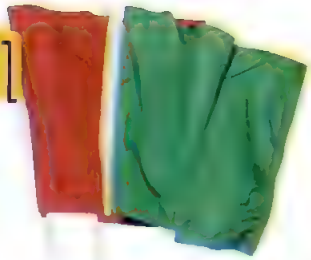


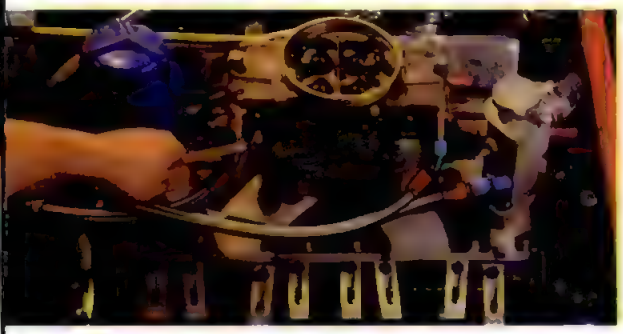
Mike Schmith, Gateway 2000 Marketing Manager, drives the Gateway race car. "Schmitty" says the race to market with the very best products for Gateway is even more intense than his weekends behind the wheel.

Gateway's Award-Winning Team Is Behind You All The Way.



Reliability & Quality

We understand you want reliability and quality, in both the products you buy and the company you buy them from. That's what you get with Gateway. In the **three** most recent reader surveys conducted by *PC Magazine*, Gateway systems received the highest ratings for reliability. We earn these awards because we use only the best quality components in our computers, and they're manufactured with Midwest pride and painstaking quality-control procedures. Gateway 2000 is also one of the most financially stable companies in the industry, assuring you that you're buying from a reliable manufacturer that can withstand the rigors of the PC Racing Series.

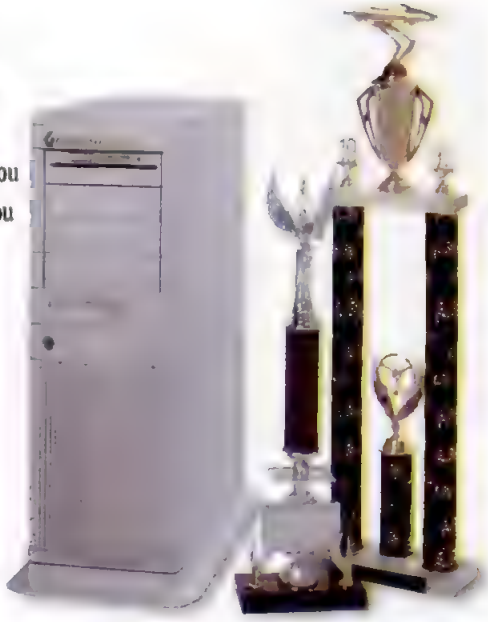


Service

We understand you want the best in service, from your first phone call through the years you own your computer. You can count on Gateway to live up to your expectations. Our Midwest representatives are friendly, caring folks. You'll feel right at home with Gateway.

Every Gateway 2000 system comes with excellent after-the-sale support. You get a 30-day money-back guarantee. If you don't like your system, send it back within 30 days for a refund.

All systems come with a one-year limited warranty and telephone technical support for the life of the system. When you need help with your PC, whether it's not working or you just have a question, you want a fast, skilled crew waiting for you in the pits. That's what you get with department. We received *PC World's* World Class Award in 1992 for best service and support in the hardware category. In February and again in July of 1993, *PC Magazine* readers gave Gateway excellent ratings for service and reliability. And in June, *BYTE* readers echoed the other awards, choosing Gateway 2000 as the company that provides the best service in the industry.



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SERVICE & RELIABILITY READERS' CHOICE

PC WORLD

BYTE Best Service

If you'd like to read our guarantee and warranty, please write to us and we'll gladly send you a free copy.

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Brent Culbertson, a Gateway 2000 Tech Support Supervisor, is Crew Chief on the race team. He spends weekends keeping the Gateway car running, weekdays keeping your systems running.

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- Mini Desktop Case with Password Protection
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- MS-DOS® 6, Diagnostics & Windows™
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- MS-DOS 6, Diagnostics & Windows
- MS Works for Windows 2.0

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- 33MHz 486DX Intel Processor
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- 5.25" & 3.5" Diskette Drives
- 340MB 13ms IDE Hard Drive
- Local Bus IDE Interface
- Intel Pentium Technology Ready
- Windows Accelerator w/ 1MB DRAM on VL-Bus™
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- Desktop Case (Tower Upgrade) with Password Protection
- 7 16-Bit ISA Slots, 2 on VL-Bus
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- MS-DOS 6, Diagnostics & Windows
- MS Works for Windows 2.0

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- Local Bus IDE Interface
- Intel Pentium Technology Ready
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- 15" Color CrystalScan 1572FS
- Desktop Case (Tower Upgrade) with Password Protection
- 7 16-Bit ISA Slots, 2 on VL-Bus
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- MS-DOS 6, Diagnostics & Windows
- Choice of Application Software

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- 16MB RAM, 256K Cache
- 5.25" & 3.5" Diskette Drives
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- 32-Bit EISA SCSI Controller
- Windows Accelerated Video w/ 1MB DRAM
- 14" Color CrystalScan 1024NI
- Tower Case with Password Protection
- 8 32-Bit EISA Slots
- 124-Key AnyKey Keyboard & MS Mouse
- MS-DOS 6, Diagnostics & Windows
- Choice of Application Software

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4DX2-66 BRIEF BUY

- 66MHz 486DX2 Intel Processor
- 8MB RAM, 128K Cache
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- Local Bus IDE Interface
- Intel Pentium Technology Ready
- Windows Accelerator w/1MB DRAM on VL-Bus
- 15" Color CrystalScan 1572FS
- Desktop Case (Tower Upgrade) with Password Protection
- 7 16-Bit ISA Slots, 2 on VL-Bus
- 124-Key AnyKey Keyboard & MS Mouse
- MS-DOS 6, Diagnostics & Windows
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SOFTWARE

If a system comes with "choice of application software," choose one of the following packages:

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- Microsoft Excel for Windows™
- Microsoft Word for Windows™
- Microsoft Word and Bookshelf '92,® CD-ROM Edition
- Microsoft PowerPoint for Windows™
- Microsoft Project for Windows™
- The MS Entrepreneur Pack
- Borland Paradox® and Quattro Pro® for Windows

All hard drive sizes are manufacturer's specified capacities. Microsoft MS-DOS 6 can increase hard drive capacity through software compression.

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Sales Hours: 7am-10pm Weekdays, 9am-4pm Saturdays (Central Time)

This ad is dedicated to the memory of NASCAR-driver Davey Allison from all his fans at Gateway.

And PC Racing Accessories

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250MB internal automatic tape backup unit copies up to 9.5MB per minute with high-speed data compression. Comes with easy-to-use DOS software, one tape and cable. **$175**

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Panasonic® KX-P2123 Color-Capable Printer

Add color to your documents with this 24-pin dot matrix printer. Includes Adobe Type Manager.® Call for price!

Texas Instruments® MicroLaser™ Plus Laser Printer

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■ Windows Utilities

HP Squeezes More Tools Into Slim Dashboard 2.0

BY BARRY SIMON

Hewlett-Packard Co.'s $99 Dashboard for Windows was an attractive and popular Windows launcher/replacement shell in its first iteration. With the release of Version 2.0, the product is strengthened by a multitude of smart improvements, including a slick pseudo-DOS window, many drag-and-drop features, a hard-disk monitor that reports free disk space, a calendar, and countless customization options. It costs $29.95 to upgrade.

The basic default look of Dashboard hasn't changed. On the top of the thin horizontal bar are tabs with the names of your Program Manager groups. Click, and you get a pop-up menu of the group's items. Below the tabs are quick-launch buttons, a clock/calendar, virtual desktop controls, a resource gauge, and push buttons to change or configure your printer drivers.

The most welcome new feature is a DOS command-line window with more functionality than any similar feature we have seen. The main part of the pop-up looks like a DOS command line, but you can launch both Windows and DOS apps from it. In some ways, the DOS command line goes beyond DOS. It has a clipboard and drag-and-drop support, for example.

After you do a directory listing in Dashboard's DOS box, you can highlight one or more files and drag and drop them as you would in File Manager. Since the DIR command allows multiple file specs (for example: DIR *.BMP;*.PCX), this can be much easier than using File Manager itself. While the DOS box is a drag-and-drop server, it can't accept filenames dragged from other drag-and-drop apps.

New customization features include an option to change Dashboard from horizontal to vertical orientation, color and font control, and resizing capabilites for the main window and subpanels. There are hotkeys to call up Dashboard or its DOS box, to switch virtual screens, and to execute the quick-launch applications. The hotkeys work from full-screen DOS boxes. You can drag and drop items from the group pop-up menus to the quick-launch buttons.

Any user of the earlier version of Dashboard will want this extensive upgrade.

TOTAL CONTROL: *Dashboard can be displayed horizontally, like this, or vertically.*

• List price: *Dashboard 2.0 for Windows, $99; upgrade, $29.95. Requires: 250K RAM, 1.5MB hard disk space, Microsoft Windows 3.1. Hewlett-Packard Co., PC Software Division, 974 E. Arques Ave., Sunnyvale, CA 94086; 800-554-1305, 408-749-9500; fax, 408-720-3574.*

Circle 404 on reader service card

■ Image Capture and Conversion

HiJaak: Still Essential After All These Years

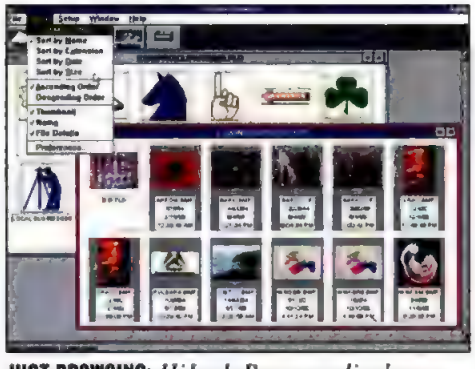
BY LORI GRUNIN

No longer content to be simply HiJaak for Windows, Inset Systems' $169 screen-capture and file-conversion utility has gone PRO in its latest incarnation. HiJaak has long been a part of the essential graphics toolkit, and turning pro hasn't decreased the program's status one bit.

One of the HiJaak PRO's most powerful new capabilities is support for the Aldus Installable Import Filter specification. Any application that supports this spec—and the list includes Aldus PageMaker, Ami Pro, Microsoft PowerPoint, and Microsoft Word for Windows—can now import files via HiJaak without having to go through the extra step of a manual translation.

Inset Systems has made some much-needed performance enhancements for file loading, zooming, and scrolling. While the speed won't leave you breathless, neither will it leave you irritated and restless.

As you might expect, there is new support for several more file formats, including CMYK TIFF, .DIB, JPEG (using U-Lead Systems' codec), .PCD (Kodak Photo CD), and .RLE. It can also now read and write non-PC file formats, such as SUN Raster and AS/400 IOCA formats, and can scan images via any scanner that comes with a Twain-compatible driver.



JUST BROWSING: *HiJaak Browser displays images in any of 70 supported formats.*

Also new in this version is the HiJaak Browser, a simple image browser and cataloging utility that lets you create virtual folders of images and perform basic file operations, such as move, copy, and delete.

For cataloging images, the HiJaak Browser is not quite as useful as the one found in U-Lead Systems' ImagePals or more sophisticated media management utilities. On the other hand, it can display any raster or vector image format supported by HiJaak; that is, any of 70 graphics file types.

During initial testing, we experienced frequent crashes that were subsequently fixed by adding the line DIBONLY=ON to the HJBROWSE.SET file that HiJaak places in the Windows program directory. This is only a temporary solution, and there should be a fix by the time you read this.

Inset Systems still hasn't addressed one of HiJaak's big weaknesses: its inability to read PostScript for conversion (although it has long been able to write PostScript files, and can read the embedded low-resolution .WMF or TIFF bitmap for screen display).

Nonetheless, anyone who deals with screen captures or file conversions will undoubtedly find this multitalented program indispensible.

• List price: *HiJaak PRO, Version 2.0, $169.* Requires: *640K RAM, 3.2MB hard disk space, Microsoft Windows 3.1. Inset Systems, 71 Commerce Dr., Brookfield, CT 06804; 800-374-6738, 203-740-2400; fax, 203-775-5634.*

Circle 405 on reader service card

■ DOS Shells

Norton Commander 4.0: For DOS Die-Hards

BY GREGG KEIZER

With updates to DOS apps becoming increasingly scarce, it's almost a shock when an upgrade hits the street without the word "Windows" somewhere in the title. Double the voltage when a DOS shell gets upgraded: Windows beats DOS hands down when it comes to manipulating files.

Symantec's $99 Norton Commander 4.0, probably the last of its line, offers enough new features and enhancements of existing options to tempt, though not shock, DOS fans, particularly those working on portables and notebooks equipped with small hard disks. Current users of the years-old Commander, though, will want to upgrade to 4.0; its new and improved functions are well worth the $39 upgrade price.

The most useful additions to Commander 4.0 are its more than 30 new file viewers, its ability to compress and decompress files, and its inclusion of directories in all file maintenance chores. Commander now lets you peek inside such file formats as .BMP, .DOC, .GIF, and .ZIP, without actually opening the files. You can also set Commander to show file contents automatically on one side of the screen while the familiar directory listing remains on the other.

Imitating most other shells, Commander 4.0 offers built-in file compression and decompression from a menu. It supports ZIP 1.*x* and 2.*x* decompression and ZIP 2.*x* compression internally; and ZIP 1.*x*, ARJ, ARC, PAK, LHARC, and ZOO formats externally through a customizable settings file. In testing, however, Commander was unable to decompress ZIP 1.*x* archives generated by WinZIP, a popular Windows front end for PKZIP.

While earlier versions of Commander refused to deal directly with whole DOS directories, 4.0 can move, copy, and delete entire directories, as well as their subdirectories. Easily overlooked, this addition alone makes the utility a worthwhile upgrade for current Commander fans.

Improvements to existing features include a more capable find file function (it now includes a text string search option), the ability to print from within the integrated editor, parallel-port support for the LapLink-like Commander Link transfer utility, and an improved MCI Mail module (from Symantec's own Norton Desktop for DOS).

LOOK INSIDE: *The Norton Commander 4.0 has viewers for several prevelant file formats.*

If you're committed to DOS for the duration and need a low-overhead shell, Commander 4.0's as good a tool as you're likely to see as DOS winds down.

• List price: *The Norton Commander, Version 4.0, $99; upgrade, $39.* Requires: *512K RAM, 2MB hard disk space, DOS 3.1 or later. Symantec Corp., 10201 Torre Ave., Cupertino, CA 95014; 800-441-7234, 408-252-3570; fax, 408-255-3344.*

Circle 407 on reader service card

■ Modems

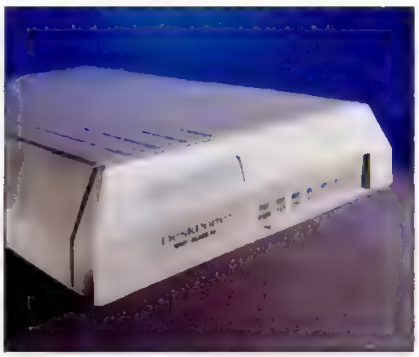
DeskPorte Communicates Over Noisy Phone Lines

BY AMARENDRA SINGH

Today's modems may be small and fast, offering the latest in V-dot standards and speeds, but not all modems are created equal. Microcom's DeskPorte ($499) is a 14,400-bps modem that supports Microcom's recently patented MNP 10 standard for enhanced reliability on noisy lines encountered during cellular, rural, and international transmissions.

Microcom knows a thing or two about modem standards. After all, it developed the series of MNP (Microcom Networking Protocol) error-correction and compression protocols that have become de facto standards. The DeskPorte supports a full range of error-correction and data-compression standards, including V32.bis, V42.bis, MNP 5, and V42. It also provides Class 1, Group III send and receive fax capabilities at 9,600 bps.

The primary advantage of the MNP 10 standard is that it lets the modem dynamically adjust the connect rate with another MNP 10 modem, depending on changing line conditions. The modem can increase its speed once a stable connection is established, and it can decrease speed in order to initiate a connection on a noisy line.



STATIC GUARD: *The DeskPorte specializes in maintaining bad connections.*

Usually, noise and static on a line cause the modem to lose the connection—and your data. The only solution is to transmit the data again. But by detecting line interference and making speed adjustments automatically, the DeskPorte minimizes retransmissions. The net benefit is significantly lower connect times and lower phone bills. You should note, however, that these benefits are realized only when both the sending and the receiving modems are equipped with MNP 10.

FAX SOFTWARE INCLUDED

The DeskPorte is bundled with Delrina's DosFax Lite and WinFax Lite, which installed quite easily and functioned without any problems while both sending and receiving. The modem does not include a communications application.

LED indicators provide a decent range of information. One of the indicators changes from red to green and blinks at a particular rate to provide information about the connect speed. Another LED provides information about errors in communications.

At $499, the DeskPorte doesn't represent a price breakthrough, but it remains a good value. If you transmit data under conditions where the lines are consistently bad, you'll find that the MNP 10 feature comes in very handy.

• List price: *Microcom DeskPorte, $499. Microcom Inc., 500 River Ridge Dr., Norwood, MA 02062; 800-822-8224, 617-551-1000; fax, 617-551-1021.*

Circle 406 on reader service card

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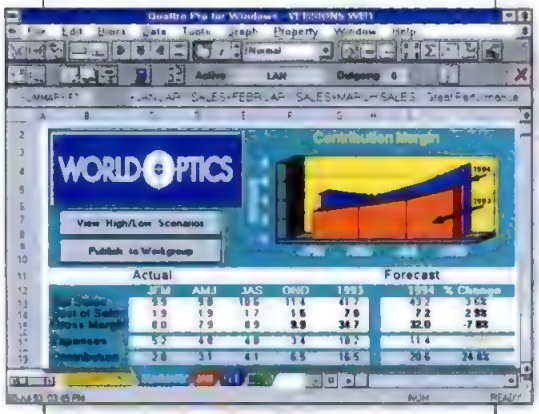
If you ever wanted to share your spreadsheet information with other workers, or automatically receive the most up-to-date information from someone else's spreadsheet, new Quattro® Pro 5.0 Workgroup Edition is for you. The new Workgroup Desktop™ makes sharing information with coworkers as easy as passing a piece of paper, only a lot faster! And with built-in support for SQL-based servers, you can view and query more information than ever before!



*Update everyone in your group at the touch of a button. let the **Workgroup Desktop** distribute your results automatically.*

Get instant access

Quattro Pro's Workgroup Edition lets you distribute your spreadsheet information to whomever you want, whenever you want, and wherever you want.

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It's automatic!

Workgroup Desktop lets you establish workgroups as needed, opening up a whole new level of information sharing. You can send complete spreadsheets—including all data, text, formatting, and

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"... a powerful, flexible workgroup strategy with greatly enhanced analytical ability."

—PC Week

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> "Quattro Pro for Windows is the most advanced, most forward-looking Windows spreadsheet to date."
> *—PC Magazine*

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■ **Databases**

Alpha Four Bulks Up for Heavy-Duty Apps

BY STEPHEN W. PLAIN

Among nonprogrammable databases, DOS-based Alpha Four has been known for its broad feature set, which has evolved substantially over the years. True to form, the $495 Alpha Four, Version 3.0, is even broader, with scores of new tools that aid in the process of creating sophisticated applications without programming.

First of all, mouse support has finally come to Alpha Four. All of the menus fully support the mouse, and four scripting commands have been added to make your applications mouse-capable.

EASIER: *Data entry is greatly improved.*

Multifile data entry, which lets you use forms containing fields from different database tables, is an added feature. The data in each table can now be directly modified. In previous versions, you had to use the Zoom key to switch between the parent and child tables. Scrolling child regions can also be displayed for detail records.

Referential integrity features have been added; they let you establish rules that govern the behavior of child records when various operations on the linked parent table are performed. Alpha Four can automatically delete any child records when the parent record is deleted, and will modify the link fields in the child table when they are changed in the parent.

Lookup tables and posting functionality have also been improved. An outliner, similar to those used to create bullet charts in presentation packages, has been added to help you create cascading lookup tables. Each user selection can determine which lookup list to display next. Conditional posting has been added so you can define the posting operation to be performed relative to data retrieved at runtime. The value of a STATUS field, for example, could determine which multitable posting job is to be performed.

To further simplify the process of developing custom applications with the application generator, you can now fully modify the menus of standard View and Browse sessions. For situations where these standard modes are sufficient for the end user, it can be a time saver.

Version 3.0 isn't an earth-shattering revision to Alpha Four, but it does offer a productivity boost to the end user as well as to the developer. Although users of Alpha Four who are waiting for front-end access to their SQL databases will be disappointed that such connectivity is not in this version, the program continues to hold its own among its competitors.

• List price: *Alpha Four, Version 3.0, $495.* Requires: *640K RAM, 4.3MB hard disk space, DOS 3.1 or later. Alpha Software Corp., One North Ave., Burlington, MA 01803; 800-451-1018, 617-229-2924; fax, 617-272-4876.*

Circle 408 on reader service card

■ **Network Utilities**

CacheAll: Speed LAN Drives from Local PCs

BY STEVE RIGNEY

Is the responsiveness of your network disappointing? How about the external LAN adapter on your laptop? CacheAll, a $129 program from C&D Programming Corp., lets you cache network drives on your own local PC, and that results in lightning fast network responses for certain operations.

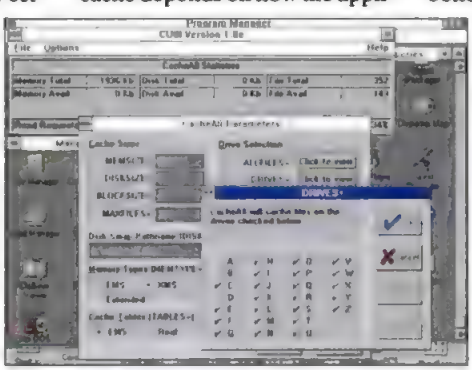
With CacheAll, you can cache almost any storage device, including CD-ROM drives and optical disks. While it is only certified to work with Artisoft's LANtastic, we tested CacheAll with NetWare 3.11 and Windows for Workgroups, and it worked without a hitch.

LOCAL SPEED

CacheAll holds data in up to 64MB of extended memory, EMS, or XMS. You can also hold cached data from a network hard disk in a swap file on a local hard disk. If you tune CacheAll correctly, many of your network operations will be at least as fast as they are on your local hard disk.

CacheAll's swap file is one of its most clever features. Using part of your hard disk space for caching is particularly useful if you don't have a lot of RAM or if you want to cache a large portion of a drive that's slower than your hard disk (a CD-ROM drive, for example). The CacheAll swap file may cause problems if you use it on a hard disk that's been compressed with a program such as Stacker or DOS 6.0's DoubleSpace, but you can create a swap file on a noncompressed hard disk.

The effectiveness of any cache depends on how the applications ask for data from the hard disk. It can work around network bottlenecks if—and only if—the same applications frequently ask for the same data. You won't want to use the client PC cache on a LAN where a lot of people are changing the same database file, because the cache can request and hold data that may have been changed.



SPEED RACER: *Change your cache setup.*

The program operates as a 21K TSR that you can load high into upper memory, but we encountered problems loading CacheAll with NetRoom 3.0 and DOS 6.0's Memmaker program. A newer version of the program worked with Memmaker.

CacheAll won't speed every network action and it will not benefit every installation, but if you have a slow server, a CD-ROM drive, or a slow network connection, it can provide an inexpensive way to speed up much of your LAN-related work.

• List price: *CacheAll, Version 1.0, $129; $79 introductory price available for a limited time.* Requires: *22K RAM, 5MB hard disk space, DOS 3.3 or later, Microsoft Windows 3.0 or later. C&D Programming Corp., 1611 Mayfair Circle, P.O. Box 581012, Salt Lake City, UT 84158; 800-847-5676, 801-582-0503; fax, 801-581-0883.*

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Lockable Front Door:	Yes	No	Yes
Professional Controls:	Yes	Yes	Yes
All-Steel Construction:	Yes	Yes	Yes
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SOLID-STEEL DESKTOP CASE $295
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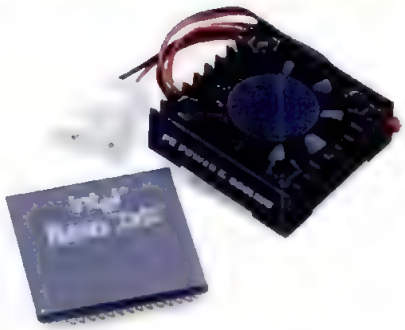
CPU COOLER



It's a fact. 486 chips run hot, often exceeding 185°F! Now, you can cool your 486 to a safe 85°-95°F with our popular **CPU-Cool**. It prevents random system errors and other heat-related problems. Consists of a mini-fan embedded in a sculptured heat sink that easily mounts on the CPU. Powered by a spare drive connector. Effective, inexpensive insurance!

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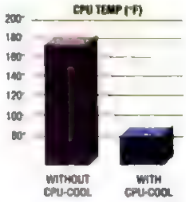

CPU-COOL $29

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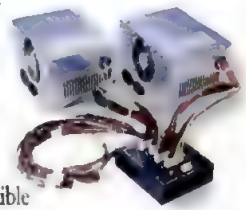
- allows dual UPSs
- monster-case compatible



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CIRCLE 060 ON READER SERVICE CARD

■ Word Processing

Word 6.0 for DOS Adds TrueType, Table Building

BY EDWARD MENDELSON

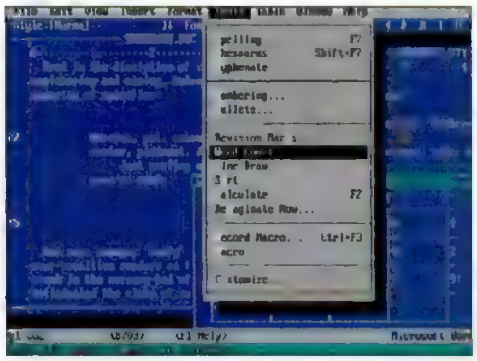
If you stayed loyal to Microsoft Word for MS-DOS when everyone around you switched to Word for Windows, Microsoft has now rewarded you with a sleek new version. Version 6.0 of Microsoft's $495 package (upgrade price, $99) enhances the Windows-style drop-down menus and formatting ribbon introduced in Version 5.5 and adds table creation, menus that guide you through the creation of mail-merge files, drag-and-drop for copying and moving text, and password protection for files.

The new version also displays TrueType fonts in its zoomable but uneditable print preview and lets you print those fonts on any printer that supports graphics. Despite its new features and up-to-date sculpted dialogue boxes, Word 6.0 preserves the familiar environment of a program that once looked revolutionary but now seems modest and cozy when compared with sleek Windows-based packages or with a DOS-based juggernaut like WordPerfect, Version 6.0. If Word 5.5 satisfied your need for a fast, capable word processor with limited graphic support, Word 6.0 adds useful features while taking nothing away—except for all references to OS/2 in the manual and menus. Unlike WordPerfect 6.0, Word 6.0 still runs on a humble 8088.

The new table feature lets you select the size of the table from the formatting ribbon and adjust column widths by dragging markers on the ruler. Tables have no built-in spreadsheet functions, although you can select a column or row, tell Word 6.0 to calculate the sum or product, and then manually insert the sum or product of the cells in another cell. Table cells can contain graphics. Be warned, though, that Word for Windows 2.0 scrambles Word 6.0 tables on import.

FONT FEATURES

Word 6.0 comes with the same 14 TrueType fonts that come with Windows, and it can work with any other TrueType font, although fonts must be imported separately for each printer driver. A new Insert Symbol menu lets you see an enlarged view of any TrueType character you choose, although most symbol and picture characters display only as generic box characters when you edit text. Compared with WordPerfect 6.0, Word 6.0 has limited printer and font support, and if you use special symbols or European characters with non-TrueType fonts, your printer may substitute characters you don't expect.



AT LAST: *A good word-count command.*

Another new feature uses symbols from the supplied TrueType fonts for "bulleted" paragraphs, and you can convert bullets to numbers. An outline feature lets you enter text in the same editing screen used for organizing outline levels.

Unlike WordPerfect 6.0, Word 6.0 supports real-time redlining and strikeout modes that mark your text as you type your changes. Word 6.0's bookmark feature helps in creating indexes and finding your way around files, and doesn't suffer from the design flaw in WordPerfect 6.0 that prevents bookmarks from overlapping. Word 6.0, however, still awkwardly stores index entries and graphics in embedded codes, and it's all too easy to move the name of a graphic or an index entry so that it prints out as an unwanted intrusion in your text while the embedded code gets left behind and performs no function.

Support for imported graphics remains erratic. .PCX files that print beautifully from WordPerfect 6.0 are unrecognizable when printed by Word 6.0, which won't give you an error message when it imports a graphic that produces only white space on a page.

NINE WINDOWS

As in earlier versions, Word lets you edit nine documents at once in mouse-resizable windows, using either text mode or a quasi-graphics mode. The latter mode displays italics, small caps, and strikeout text using a generic screen font but doesn't differentiate between typefaces or point sizes. Word 6.0 offers the uncommon ability to edit two or more parts of the same file in different windows and retain the edits from every window. The uneditable print preview is almost WYSIWYG quality, although imported graphics display at a snail's pace.

Word 6.0 lets you clutter its screen with scroll bars; pull-down menus; a status bar; window borders; and a ruler that lets you adjust tabs, margins, and column widths with the mouse. Additionally, there's a format ribbon that lets you select styles, change fonts, open tables, and indent paragraphs with a mouse click. You can also clear the screen of everything except text. A small but valuable improvement lets you get a word count with two keystrokes even when the status bar is turned off.

When you install a printer, Word 6.0 generates a document that describes its capabilities but leaves important details vague. If you want 600-dot-per-inch line art from an HP LaserJet 4, you may be alarmed to find nothing higher than 300 dots per inch on the print menu, but you'll get 600 dots per inch if you choose the obscure HPGL2_HI setting.

Die-hard users who fear leaving the quick but eccentric interfaces of Word, Versions 1.0 through 5.0 (which use Escape-Transfer-Load instead of File/Open), will find in Word 6.0 a help screen to ease the transition and an option to retain Version 5.0's function-key layout. Word 6.0 won't tempt anyone to abandon a different DOS word processor, but all users of Word 5.5 will want to upgrade for the new version's evolutionary enhancements. □

FACT FILE

Microsoft Word 6.0 for MS-DOS
Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-426-9400, 206-882-8080; fax, 206-936-7329

List price: $495, upgrade, $129 ($99 through September 30)
Requires: 384K RAM (512K recommended), 1.5MB hard disk space (5.5MB for full installation), DOS 3.0 or later
In short: Microsoft Word for MS-DOS 6.0 looks and acts like Word 5.5 but adds support for tables, TrueType fonts, bulleted lists, and a zoomable print preview. Word won't win any converts with its new version, but existing users will be pleased with the upgrade
403 READER SERVICE CARD

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16-Bit.

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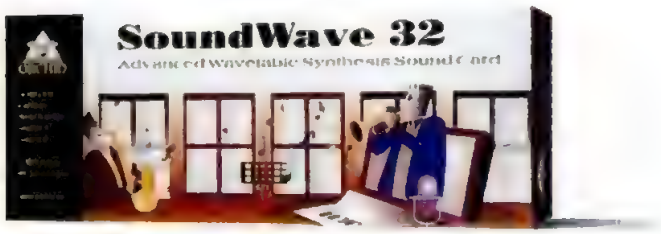
Signal Processor.



Infriggincredible.

Fire up your favorite game and get ready to be blown away. Because now every sound you couldn't hear with those other boards is going to come storming out of your PC with intensity like you've never heard before. Introducing Orchid's signal processing SoundWave 32.

SoundWave 32 is nothing short of a revolution in sound, with its own rocket-quick RISC signal processing chip (DSP). While other boards try to stuff their puny sounds through slow, outdated FM chips, SoundWave 32's 20 megahertz signal processor rushes out rich, 16-bit sound. With incredible clarity and separation.

And there's more. Not only do you get dual CD-ROM interfaces and free stuff like stereo speakers, a microphone and a stereo cable, but SoundWave 32 also gives you amazing wavetable sampled sound. So when the game calls for a killer riff, you don't just hear a computer simulation of a guitar, you hear the real, recorded instrument.

Of course, SoundWave 32 is compatible with everything —SoundBlaster, AdLib, General MIDI, Microsoft Windows Sound System, and Roland MPU-401 MIDI Interface, and for you game players, Roland MT-32 sound module. And with just a simple change of software, its signal processor will handle any new sound format that comes along.

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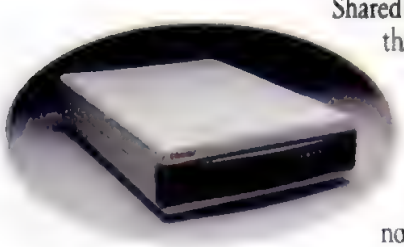
CIRCLE 350 ON READER SERVICE CARD

Most Remote Access Solutions End Up Looking Like This.

When It Comes To Remote Access To Your LAN, There Are Two Ways To Go: "Cut And Paste" Or "Plug And Play."

Why struggle with a jerry-rigged solution that's hard to use and messy to maintain? U.S. Robotics introduces the Shared Access™ Communication Server 386™ and LAN modem. Easy, complete solutions that give all your users transparent remote access to Novell™ LANs.



Easy to install, each product includes an Ethernet NIC, an upgradable modem and all the software you need to dial in and dial out. Plus the Comm Server 386 has a dedicated 386 processor.

Easy to support, these are the only products with both remote control and remote node. Switch seamlessly between the two access modes for unprecedented ease of use!

Today's only full family of products, Shared Access takes the "cut and paste" out of remote access technology. And dollar-for-dollar, a Shared Access solution is more affordable: only $1695 for the LAN modem and $1995 for the Comm Server 386.

So get the "Plug and Play" remote LAN access solution from U.S.Robotics. Call 1-800-DIAL-USR today.

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CIRCLE 920 ON READER SERVICE CARD

New & Improved

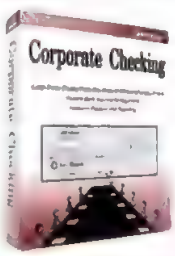
NEWS OF ANNOUNCED PRODUCTS AND UPGRADES

By Brad Grimes

NEW

With MICR Toner You Can Print Checks on Your Laser Printer

In August 1992, Hewlett-Packard introduced a toner cartridge that let companies print blank or filled-in checks on laser printers instead of on expensive magnetic-ink character-recognition (MICR) printers. Today, three vendors are shipping DOS-based software that utilizes special MICR fonts and takes advantage of MICR cartridges for HP and other laser printers. The first is **Academy Systems**' Corporate Checking, Version DS, which not only prints checks but also features Accounts Payable, General Ledger, and Trial Balance modules. Academy also has a product called CheckMaker, which acts as a check-printing add-on to your favorite accounting or financial management software. Both of Academy's products come in separate versions for two checking accounts and for unlimited accounts, as well as in network versions.



Create-A-Check's namesake product is used with accounting and financial management software, and it includes features such as Design-A-Check (for designing custom formats with logos and signatures), and Trace-A-Check (for securing the transactions of your checking accounts). Create-A-Check comes in personal, professional, and corporate editions.

From **Magnetic Software** comes BlankCheck, which also works with financial software and comes in basic, enhanced, and corporate versions (depending on the number of checking accounts you have). The corporate version lets you design your own checks from the ground up and supports 300 accounts.

• List price: *Corporate Checking, Version DS (two accounts), $199; CheckMaker, Version DS $89. Academy Systems Inc., 1327 E. 10th St., Brooklyn, NY 11230; 800-446-6619, 718-253-4227. Create-A-Check Personal, $249.95. Create-A-Check Inc., 438 East 200 South, #300, Salt Lake City, UT 84111; 800-621-5720, 801-322-5222. BlankCheck Basic, $149.95. Magnetic Software, P.O. Box 1703, Mount Airy, NC 27030; 800-628-6427, 919-786-1336.*

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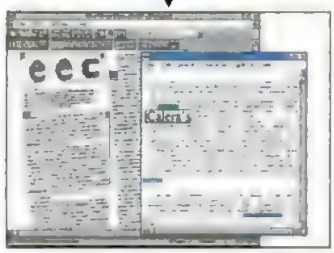
HOT PROSPECT



Calera Takes OCR to the Next Level in WordScan Plus 2.0

WordScan and WordScan Plus from Calera Recognition Systems are already known as highly accurate optical character recognition (OCR) programs, but with Version 2.0 of both products (WordScan is a scaled-down, personal version of WordScan Plus), Calera provides an even more accurate OCR technology and a host of other high-performance features. Calera's new 32-bit Adaptive Recognition Technology (ART) uses a knowledge base of information describing certain page layouts and characters. ART then applies contextual information during the recognition process to identify characters based on whole words or pages rather than on a character-by-character basis.

WordScan and WordScan Plus now support Object Linking and Embedding (OLE) 2.0, and Calera's OCR Aware lets you access WordScan Plus from within a Windows application. WordScan Plus also supports VIM and MAPI, so you can electronically mail text and image files from within WordScan Plus.

WordScan and WordScan Plus users can upgrade to Version 2.0 for $59 and $99, respectively. Current WordScan users can upgrade to WordScan Plus 2.0 for $119.

• List price: *WordScan Plus, Version 2.0, $695; WordScan, Version 2.0, $295. Calera Recognition Systems Inc., 475 Potrero Ave., Sunnyvale, CA 94086; 800-422-5372, 408-720-8300; fax, 408-720-1330.*

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NEW

Philips Monitors Have Digital Image Control, Stereo Audio

Its name isn't normally associated with monitors, but **Philips Consumer Electronics Co.** is making a mark in the field with its new line of Brilliance monitors. The Brilliance 15 is a 15-inch flat-screen multimedia monitor with a built-in stereo amplifier, speakers, headphone jack, and user-adjustable volume control. The Brilliance 17 model has a 0.27-mm dot pitch, supports a refresh rate of 76 Hz at 1,280-by-1,024 resolution, and features digital control with 27 display modes. Philips' top-of-the-line 21-inch monitor, the Brilliance 21, has a 0.28-mm dot pitch and also supports a refresh rate of 76 Hz at 1,280-by-1,024 (it also comes in a 20-inch model, which supports a maximum resolution of 1,280-by-1,024 for $2,499). All three monitors exceed low-emission standards.

• List price: *Brilliance 15, $699; Brilliance 17, $1,499; Brilliance 21, $2,999. Philips Consumer Electronics Co., One Philips Dr., P.O. Box 14810, Knoxville, TN 37914-1810; 800-835-3506, 310-217-1300.*

Circle 413 on reader service card

NEW

Back Up Your Data Without Hindering System Performance

Back In A Flash!, the new OS/2 2.1 archive and backup utility from **CCT,** is a true 32-bit application that uses OS/2's preemptive multitasking and multithreading capabilities to perform backups while you work, with almost no system performance hit. It also lets you back up data to floppy disks, magneto-optical disks, hard disks, and network drives, at scheduled or regular intervals. Back In A Flash! features file compression and support for hidden files, system files, and open files, and a backup log. You can define backup routines to address special requirements. In the event of a worst-case scenario, it has a command line restore function.

• List price: *Back In A Flash!, $49 ($29 until September 14). CCT Inc., 111 Third Ave. South, Minneapolis, MN 55401; 612-339-5870, fax, 612-339-5965.*

Circle 414 on reader service card

Photography by Thom O'Connor

NEW

Panasonic Ships RISC-Based PostScript Laser Printer

Panasonic Communications & Systems Co. has announced a pair of desktop laser printers based on Intel's i960 RISC processor. The Panasonic KX-P5410 Laser Partner is a 300-dot-per-inch, 5-page-per-minute printer with 17 Adobe PostScript Level 2 fonts that can also receive faxes using the PostScript language. It comes with 2MB of memory and 28 internal bitmapped fonts for use in HP LaserJet IIP emulation mode.

The Panasonic KX-P4440 Laser Partner replaces the KX-P4450i and KX-P4451 models in a multiuser environment. It is PCL 5–compatible and can operate at 10 pages per minute and 300 dots per inch. It comes with 1MB of memory, 8 outline fonts, 28 bitmapped fonts, and Panasonic's SatinPrint resolution enhancement technology.

• List price: *Panasonic KX-P5410 Laser Partner, $1,399; Panasonic KX-P4440 Laser Partner, $1,449. Panasonic Communications & Systems Co., Two Panasonic Way, Secaucus, NJ 07094; 800-742-8086, 201-348-7000.*
Circle 416 on reader service card

NEW

Ocean Isle Software Gives You Total Remote Control

Ocean Isle Software's new ReachOut Total Remote combines remote-control and remote-access functionality in a single program. This gives you the ability to share network resources, such as fax servers, when you dial in, or even retrieve data from a PC that is running another program. Total Remote can also run across dissimilar networks, so you can connect to one network from another and access any of its files Like ReachOut Remote Control, Total Remote works under DOS and Windows, and provides quick file transfers and tight security. Current users of Remote Control can upgrade by purchasing the Remote Access option for $79.

• List price: *ReachOut Total Remote, $249. Ocean Isle Software Inc., 1201 19th Pl., 2nd floor, Vero Beach, FL 32960; 800-677-6232, 407-770-4777; fax, 407-770-4779.*
Circle 415 on reader service card

BRIEFS

SOFTWARE

Baseline Data Systems has released Version 2.1 of Office Accelerator ($129.95), its relational database program that installs as a set of commands on the menu bar of Windows word processors and lets you quickly generate letters, envelopes, faxes, and more. Version 2.1 can run on a network, so you can access a shared database. It supports postal bar codes and all major fax software programs. 800-429-5325, 310-214-8528

The two newest products from **Landmark Research International** are WINProbe ($49), a Windows troubleshooter and optimizer, and DOS for Windows ($49), a Windows program that looks and acts like DOS. If you use DOS for Windows, this program enables you to launch Windows applications from a command line, effectively replacing the Program Manager. 800-683-6696, 813-443-1331.

The London Company is shipping Perfection! ($79), a collection of four WordPerfect add-ons including FormHeaven, a library of over 150 predesigned business forms; SeeThru, which includes a variety of stamps such as "Ruch" and "Confidential" and over 90 background messages and graphics; MacroMania, an assembly of over 300 macros for WordPerfect; and FaxHeaven, a collection of 60 fax cover sheets. 212-642-8133.

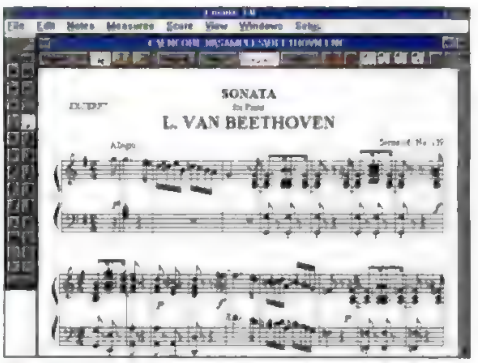
Looking Glass Software's HyperWrite hypertext presentation tool is now called ViperWrite, and is in Version 2.0. ViperWrite 2.0 ($199.95) supports OLE, enabling you to add sound and video to hypertext presentations. If you buy the ViperWrite Development Kit for $595.95, you can ship unlimited copies of the Viper Presentation Engine with your applications. 310-348-8240.

Media Cybernetics has announced Image-Pro Plus for Windows ($1,999), a high-end image processing software program for scientific imaging. It is based on the vendor's HALO Advanced Imaging Library. 800-992-4256, 301-495-3305.

IMPROVED

Mozart's Computer Would Run Encore for Windows 3.0

Passport Designs has taken the ability to compose music on the PC to a higher level with Version 3.0 of Encore for Windows. The user interface has new menus, tools, and palettes, plus a new array of music symbols. If you prefer Bob Dylan to Mozart, Encore 3.0 can automatically convert notes to guitar tablature, including correct fingerings, when you enter music on a MIDI keyboard. Now that Encore 3.0 supports EPS, you can export complete or partial scores to desktop publishing or word processing programs. Version 3.0 retains click-and-drag editing and real-time transcription of input from MIDI instruments.



With Encore for Windows 3.0, the music you compose on your PC is better than ever.

• List price: *Encore for Windows, Version 3.0, $595 (upgrade for $99). Passport Designs Inc., 100 Stone Pine Rd., Half Moon Bay, CA 94019; 415-726-0280; fax, 415-726-2254.*
Circle 417 on reader service card

IMPROVED

Microsoft Shops Around, Fills Holes in Microsoft Mail

Microsoft Mail has long been a powerful e-mail product, but there always seemed to be another program that had that one extra, attractive feature. Now **Microsoft Corp.** has announced Microsoft Mail Special Edition, which draws new capabilities from a group of outside software vendors. The Special Edition incorporates WinRules from Beyond Inc., makers of BeyondMail, for handling messages based on user-defined criteria; Absentee Manager, from Management Software Holdings, for sorting and forwarding e-mail when you're out of the office; and Outside In, from Systems Compatibility Corp., for viewing

Like most color printers, this one works best if you use the right paper.

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Color printing on plain paper is, no doubt about it, a remarkable achievement. But we know there are times when you wish you weren't limited to an 8½″ x 11″ white piece of paper. You know, those times when you need a Phaser™ III color printer.

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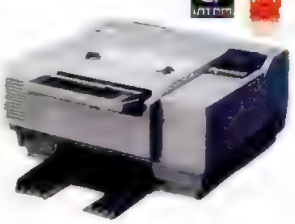
Call 800/835-6100, Dept. 30-E for a free output sample. If you can't wait and want more information, we'll gladly fax it to you. Just call 503/682-7450 and ask for document 1230.



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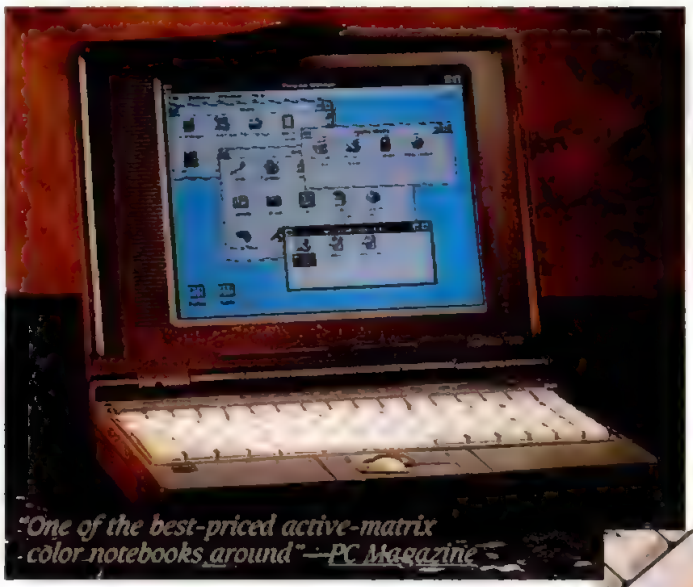
CIRCLE 001 ON READER SERVICE CARD

THE NEW COLOR NOTEBOOK



"One of the best-priced active-matrix color notebooks around" —PC Magazine

If you're chasing power, speed and state-of-the-art notebook color technology, get ready to pounce on the new AcerNote 750c. Just one in a series of modular notebook computers from Acer, the AcerNote 750c is packed with outstanding features to give you the best that mobile computing has to offer.

ACTIVE-MATRIX COLOR AND PCMCIA— THE LATEST NOTEBOOK TECHNOLOGIES

With the AcerNote 750c you benefit from a high performance 486 CPU and a big 9.5" active-matrix TFT color display with 256 brilliant colors in 640 x 480 resolution. One PCMCIA Type III slot which accepts two Type II devices gives you the most flexible and easy-to-use peripheral expansion capabilities available today. Just plug in a credit card-sized PC card and you can fax data, tap into your network or access a CD-ROM player.

AcerNote 750c
Active-matrix Color with PCMCIA

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- Accepts Two Type II Devices
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- SmartCase Modular Housing
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- PCMCIA Drivers

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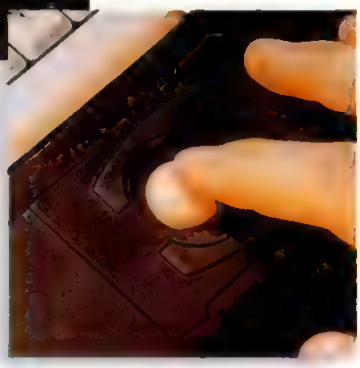

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AcerNote 750
Non-glare Monochrome with PCMCIA

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AcerNote 730c
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- Palmrest/Integrated Trackball
- 9.5" Color LCD
- Internal Fax Modem
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message attachments in over 120 file formats. Upgrading information was not available at press time.

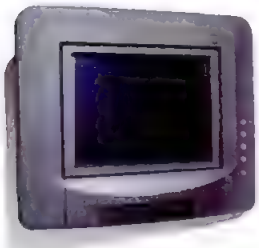
• List price: *Microsoft Mail Special Edition, $995. Microsoft Corp., One Microsoft Way, Redmond, WA 98052-6399; 800-426-9400, 206-882-8080; fax, 206-936-7329.*

Circle *420 on reader service card*

NEW

Dolch Introduces Touch-Screen Overhead Projection Panel

Dolch Computer Systems' new PRISM (PRojection and Integrated Standalone Monitor) family of 16-million color TFT (thin-film transistor) overhead projection panels includes a model with interactive touch sensitivity. The Touch & Show version of PRISM 10.4-inch and 8.5-inch panels lets presenters point a finger to navigate multimedia presentations. You can input live video in NTSC, SECAM, or PAL formats, and an RS-232 port gives you the option to control the presentation PC with a remote controller. When you're not using an overhead projector, the PRISM attaches to a backlight and becomes a standalone VGA monitor.



Dolch's new PRISM projection panel can also serve as a standalone monitor.

• List price: *Dolch PRISM PR-1650TS (10.4-inch), $7,995; Dolch PRISM PR-1150TS (8.5-inch), $6,495. Dolch Computer Systems, 372 Turquoise St., Milpitas, CA 95035; 800-538-7506, 408-957-6575; fax, 408-263-6305.*

Circle 419 on reader service card

NEW

A PIM with a Twist: This One's for OS/2

With IBM's blessing (and some of its marketing power), **Arcadia Technologies** has released a personal information manager called the Arcadia Workplace Companion for OS/2 that is designed for OS/2 2.1's 32-bit Workplace Shell environment, complete with pop-up context menus, notebook controls, and drag-and-drop abilities. The Companion has a calendar and a clock module from which you can launch into an appointment book, a telephone/address book, a to-do list, or a notepad. Its object-oriented design is so intuitive that contacts in the Arcadia Phone Book appear as people on a page that can be accessed or manipulated with the mouse. The Phone Book also lets you place, answer, and log calls.

• List price: *Arcadia Workplace Companion for OS/2, $149.95. Arcadia Technologies Inc., 735 W. Duarte Rd., #207, Arcadia, CA 91007; 800-342-6672, 818-446-6945; fax, 818-447-4212.*

Circle 421 on reader service card

BRIEFS

SOFTWARE

PageAhead Software Corp.'s new InfoPublisher 2.0 ($295) database publishing program is compliant with Microsoft's Open Database Connectivity (ODBC) standard. The designers at PageAhead Software have improved the program's user interface, and they have integrated InfoPublisher tightly with PageMaker and WordPerfect for Windows. A developer's kit is available for $495. 800-967-9671, 206-441-0340.

Startup vendor **PowerPro Software** has announced an auto-resume utility that works with DOS and Windows on either a desktop PC or a portable PC. Quick Restart ($39.95) saves your current system settings (including all open applications) to disk when you hit a hotkey or click the mouse. When you power-on your PC again, you just hit a predefined key and the system returns to the exact state it was in when you turned it off. 415-345-9278

Stairway Software is shipping version 2.0 of its best-selling word processor utility MergeMaster. MergeMaster 2.0 ($79.95, upgrade; $29.95) makes it easier to pull database information into popular DOS and Windows word processors, including WordPerfect 6.0. 800-782-4792, 804-437-7000.

CD-ROMS

Aris Entertainment is shipping a host of new CD-ROM titles. Among them is the second version of MPC Wizard ($14.95), the best-selling collection of Windows 3.1 video and sound drivers and multimedia clips. Version 2.0 includes five runtime videos to use with Microsoft's Video for Windows. Also from Aris is the first in its e-World series of interactive movies, which use Aris' new VideoPlay software. The title, Alternating Currents ($34.95), is a 40-minute mystery/adventure story. Meanwhile, Video Cube: Space ($49.95) is the first in a series of interactive puzzles incorporating over 100 video clips. 310-821-0234.

Compton's NewMedia is publishing The Human Calculator ($39.95), based on the mathematical teaching techniques of Scott Flansburg. The Human

IMPROVED

Logitech Redesigns Hand-Held Scanner, Adds OmniPage

The recently announced Logitech ScanMan EasyTouch represents another effort by **Logitech** to redesign its products with ergonomics in mind. The new ScanMan EasyTouch fits more comfortably in the palm of your hand and extends straight out from the wrist. It plugs directly into the parallel port, and has a pass-through adapter so you can operate a printer at the same time. The scanner comes with Logitech's FotoTouch Color image-editing software and OmniPage Direct AnyFont OCR software, which was developed for Logitech scanners by Caere Corp. and tailored to the needs of hand-held scanning.

• List price: *Logitech ScanMan EasyTouch, $399. Logitech Inc., 6505 Kaiser Dr., Fremont, CA 94555; 800-231-7717, 510-795-8500; fax, 510-792-8901.*

Circle 422 on reader service card

NEW

WinSales: A Contact Manager That Works the Way You Work

From the fertile software grounds of the state of Washington comes a company called **WinSales** and its namesake high-end contact management and lead tracking program. WinSales uses a multiwindow paradigm to let you create an environment that suits the way you deal with contacts. By opening multiple windows of contact information, you can conduct several activities and view different pieces of data simultaneously. The WinSales Administrator utility lets you easily customize your contact manager by defining fields in data windows or creating new windows to correspond to special information.

As a lead tracker, WinSales has tools such as an organizational chart feature and an assortment of predefined reports. WinSales also lets you generate scripts with embedded fields for obtaining responses from contacts. Statistics

MAKE YOUR WORK LOOK LIKE A 1,000,000

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PC MAGAZINE EDITORS' CHOICE

March 16, 1993
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CRT Size	14"	14"	14"	14"	15"FS	17"FS
Dot Pitch (mm)	0.28	0.28	0.28	0.28	0.28	0.26
Active Display Size (mm) *	267x200	267x200	267x200	267x200	280x210	316x237
H-Frequency (KHz)	30-38	30-50	30-58	30-64	30-64	30-64
Vertical Scanning (Hz)	50-100	50-100	50-100	50-100	50-100	50-100
VESA 640x480@72Hz	•	•	•	•	•	•
VESA 800x600@56/60Hz	•	•	•	•	•	•
VESA 800x600@72Hz		•	•	•	•	•
VESA 1024x768@60Hz		•	•	•	•	•
VESA 1024x768@70/72Hz			•	•	•	•
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With WinSales' namesake product, you manage contact information any way you like.

from these scripts can be generated with a spreadsheet interface or the built-in report writer. You can create your own reports by dragging data fields from any windowed activity and combining them in one layout. A search function helps you fill in your report.

• List price: *WinSales, $495 (five users, $1,495). WinSales Inc., 25018 104th Ave. SE, Suite C, Kent, WA 98031; 206-854-9580; fax, 206-852-5434.*

Circle 423 on reader service card

IMPROVED

Avantos Upgrades Software for Managing People and Goals

Is it a contact manager, a personal information manager, or a project manager? Whatever combination of the three it is, **Avantos Performance Systems'** ManagePro, Version 2.0 for Windows, continues to be a unique tool for company managers. Version 2.0 adds significant multiuser capabilities, such as a simultaneous read/write feature that enables many managers to update and view information at the same time. Another new feature synchronizes copies of a database to support mobile users. ManagePro 2.0 also lets managers assign more than one person to a goal so that they share responsibility.

ManagePro 2.0 now supports MAPI and VIM e-mail programs, and when Macintosh and Unix versions of the product are available, users on multiple platforms will be able to access a common database. There are also a number of new tools that resemble PIM tools, including an appointment calendar, a to-do list, and weekly and daily printout reports.

• List price: *ManagePro, Version 2.0 for Windows, $395. Avantos Performance Systems Inc., 5900 Hollis St., Suite C, Emeryville, CA 94608; 800-282-6867, 510-654-4600; fax, 510-654-1276.*

Circle 418 on reader service card

BRIEFS

CD-ROMS

Calculator program leads young people through methods of mathematics that are quick and easy to understand using various games and adventures to pique interest. The program is also available on floppy disks for $59.95. 619-929-2500.

Dialog Information Services has announced Dialog OnDisc Environmental Chemistry, Health & Safety ($1,495 for an annual subscription, updated quarterly), which is targeted towards professional chemists, environmental consultants, and researchers, and provides information on such topics as animal and microbiological hazards, corporate environmental issues, legislation and standards, and waste management. 800-334-2564, 415-858-3785

On CD-ROM from **Grolier Electronic Publishing** is the 1993 Guinness Multimedia Disc of Records ($99), which contains everything from the book version along with video clips and synchronized audio. 800-356-5590, 203-797-3500.

Golf fans with a CD-ROM drive may enjoy **Microsoft Corp.**'s Microsoft Golf for Windows, Multimedia Edition ($64.95), the vendor's latest collaboration with Access Software. Video clips including aerial flybys of holes (like the ones you see on TV), customizable sounds, and interactive help highlight the new release. 800-426-9400, 206-882-8080.

Southern Software is shipping The Works ($549), a CD-ROM that contains 1,555 fonts in Adobe Type 1 or TrueType formats. The fonts come from over 350 typeface families. Site licenses are available for $100 per additional PC 813-625-3607.

3G Graphics' six highly acclaimed Images With Impact! libraries are now together on Images With Impact! CD-ROM, Version 2.0 ($499.95). The CD-ROM contains over 1,700 images in standard EPS files as well as in .BMP and .EMF formats. 800-456-0234, 206-774-3518.

IMPROVED

NCR Enhances Best-Selling PC, Offers New Three-Year Warranty

NCR Corp. has taken its best-selling low-cost workstation, the NCR System 3230, and thrown in high-performance features such as VESA local bus graphics and a ZIF (Zero Insertion Force) socket for Intel's Pentium processor. The ISA-based System 3230 Local Bus supports a wide range of Intel 486 processors, and comes with 4MB of RAM, a 120MB hard disk, 1MB of video RAM, and a flash BIOS. Memory is expandable to 32MB, and NCR offers IDE hard disks up to 520MB in capacity. To show they're still among the major PC vendors, NCR is offering the first three-year on-site warranty in the industry. If you prefer other models in the System 3000 line, you can enjoy all the enhancements made to the 3230 in new local-bus versions.

• List price: *NCR System 3230 Local Bus (25-MHz 486SX model), $1,215. NCR Corp., 1700 S. Patterson Blvd., Dayton, OH 45479; 800-225-5627, 513-445-5000; fax, 513-445-4184.*

Circle 424 on reader service card

IMPROVED

Where Memory Commander Finds All That Memory Is a Mystery

V Communications is so sure you'll free up more conventional memory with Version 4.0 of Memory Commander that it's offering a half-price competitive upgrade and a 60-day unconditional money-back guarantee. Without messing up your AUTOEXEC.BAT and CONFIG.SYS files, Memory Commander 4.0 loads TSRs and device drivers high, optimizing the high memory area, and then takes unused high memory and adds it to your conventional memory for use with large DOS programs. It also has an automatic optimizer that constantly detects new TSRs and drivers and then offers to reoptimize the high memory area. This optimization function is compatible with most disk compression software.

• List price: *Memory Commander, Version 4.0, $99.95 (competitive upgrade, $49.95). V Communications Inc., 4320 Stevens Creek Blvd., #275, San Jose, CA 95129; 800-648-8266, 408-296-4224; fax, 408-296-4441.*

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018717 Pacific Connect Xi (7 port) 4MB — IIISi, 4, 4Si, PaintJet XL300, DesignJet, DeskJet 1200C — $829
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Hardware Review, United Feature Syndicate

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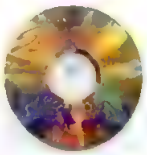

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REVIEWS OF THE LATEST BOOKS FOR THE PC USER

Edited by Carol Levin

Four Dictionaries Define the Language of Computers

BY RUBIN RABINOVITZ

Quick: Can you explain the difference between a terabyte and a Trojan horse? Between multitasking and multilaunching? If esoteric computer jargon leaves you scratching your head, you need a specialized dictionary.

We subjected four computer dictionaries to a test of 100 computer terms and can report that there are a number of good dictionaries out there—and also some good bargains.

If you're looking for a dictionary that's comprehensive and authoritative, you won't go wrong with Alan Freedman's *The Computer Glossary,* Sixth Edition. Its 5,400 entries are intelligently chosen, and its definitions are thorough and knowledgeable.

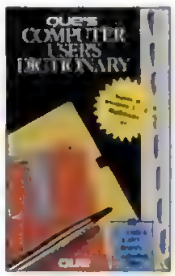
Its score of 90 percent was the highest for the dictionaries we tested. You'll find names of programs, DOS commands, slang terms, abbreviations, and phonetic cross-references. It also has the extras you won't find in other dictionaries: a DOS tutorial, a chart of the ASCII character set, an essay on binary numbers, and lists of file-name extensions, BBS numbers, and X-dot and V-dot communications standards. The 400 photographs, drawings, and charts also enhance the text. Its one weakness is its lack of recent terms: *wallpaper, toolbar,* and *cascade.*

You can get the full text of the glossary on-disk in either the DOS or Windows version. The software offers handy features, such as searching and quick look-up routines. *The Computer Glossary* isn't exactly cheap at $24.95, but you can get the paperback and disk together for $39.95—and that's a bargain.

If you're tired of colorless, conventional reference sources, *Jargon: An Informal Dictionary of Computer Terms,* First Edition, is for you. Chatty and humorous, it comes with cartoons and a crossword puzzle. *Jargon*'s style is easily accessible, and its definitions are thorough and detailed. But this thoroughness comes at the price of breadth: *Jargon* scored only 72 percent on our test. It missed such terms as *hotkey, interrupt, gateway,* and *twisted-pair cable.*

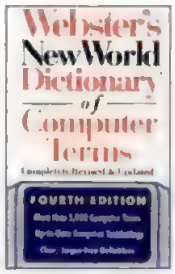
Jargon has about 1,300 main entries with 8,000 other terms in an index (this can add extra steps to look-ups). Some choices for listings are quirky: You'll find a main entry for VisiCalc but not for Excel. Even so, *Jargon,* at $22, covers the basics well, offering a combination of depth, informality, and clarity that makes it a logical choice for computer novices.

Que's Computer User's Dictionary, Third Edition, is businesslike, giving short, clear definitions for frequently used terms. Although it contains only about 2,500 entries, *Que's* covers the essentials effectively, and it chalked up a respectable 84 percent on our test.



Que's is up-to-date and does well on recent terms, covering popular application programs, slang expressions, and file-name extensions. In addition, it has useful tips on how you can work better. Priced at $12.95, it's the dictionary of choice for bargain-hunters.

The Electronic Edition ($29.95), based on the 1991 Second Edition, has some 20 percent fewer entries than the printed Third Edition and got 79 percent on our test. But the on-line version makes life easier: quick look-ups, cross-referencing, and a Boolean search.



Despite 5,000 entries, *Webster's New World Dictionary of Computer Terms,* Fourth Edition, got the lowest score on our test—70 percent. Revised in 1992, *Webster's* is still dated, covering older programs like QuickBASIC and QuickC but not Quicken, a recent best-seller. It can't define *multilaunching* and *PIM,* and it missed easy Windows terms such as *PIF, cascade, WIN.INI,* and *wallpaper.* It doesn't have numeric entries, so you won't find such items as *3Com 3+* or *80386.*

Webster's definitions are short and sometimes imprecise: *Downloading* is defined as moving data from a large computer to a smaller one (in fact, the computers' sizes are irrelevant). *Multimedia* is defined only as multiple types of media; no reference is made to multimedia computing or the Multimedia Personal Computer (MPC) standard. *Webster's* lacks illustrations and has few of the extras offered in other dictionaries. Its one strong suit is price: It sells for only $8.95.

And if you're still scratching your head, a terabyte is a million megabytes, a Trojan horse is a destructive computer program, multitasking involves running different programs simultaneously on one PC, and multilaunching lets different network users open the same program simultaneously. □

- **The Computer Glossary, Sixth Edition,** *by Alan Freedman, $24.95; with disk for DOS or Windows, $39.95. Amacom; 800-262-9699. ISBN: 0-8144-7809-3.*
  Circle 452 on reader service card
- **Jargon: An Informal Dictionary of Computer Terms, First Edition,** *by Robin Williams, with Steve Cummings, $22. Peachpit Press; 800-283-9444. ISBN: 0-938151-84-3.*
  Circle 453 on reader service card
- **Que's Computer User's Dictionary, Third Edition,** *by Bryan Pfaffenberger, $12.95;* **Que's Computer User's Dictionary, Electronic Edition,** *$29.95 for DOS or Windows version. Que Software; 800-992-0244. ISBN: 1-56529-023-2.*
  Circle 454 on reader service card
- **Webster's New World Dictionary of Computer Terms, Fourth Edition,** *by Donald Spencer, $8.95. Prentice Hall General Reference; 800-223-2336. ISBN: 0-671-84651-5.*
  Circle 455 on reader service card

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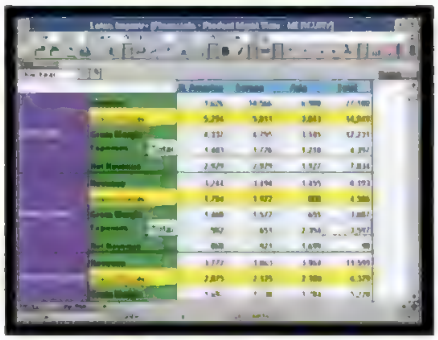

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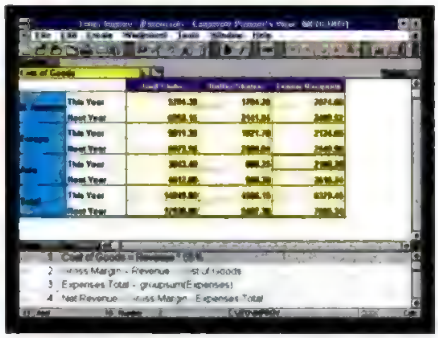

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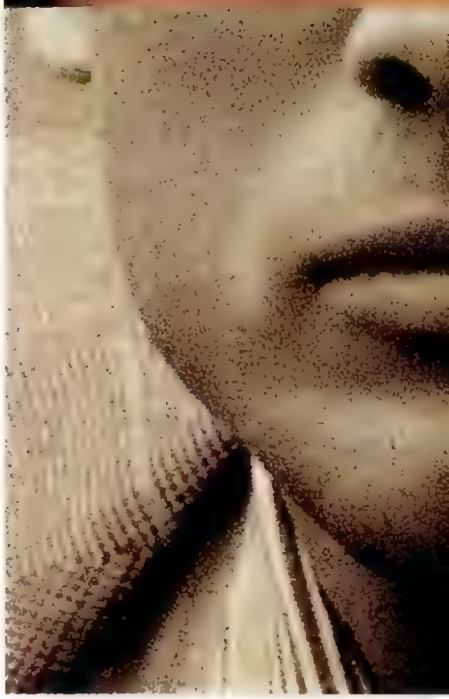

*Anyone who bought Improv Release 2.0 can get the network ready edition of Improv Release 2.1. WK4 support and the Application Field Exchange features free in an update kit. O+E Extend will not be available as part Improv for NeXT® CA Compete and Symphony® ***In Canada call **1-800-GO-LOTUS**. ©1993 Lotus Development Corporation, 55 Cambridge Parkway, Cambridge, MA 02142. All rights reserved. Lotus, 1-2-3, Lotus of Microsoft Corporation. Quattro is a registered

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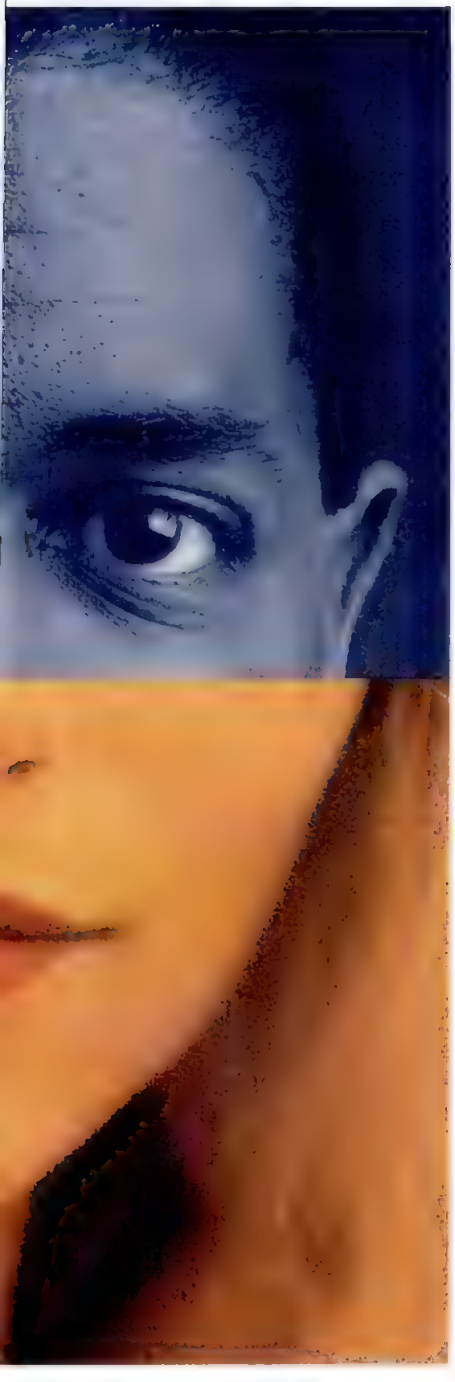

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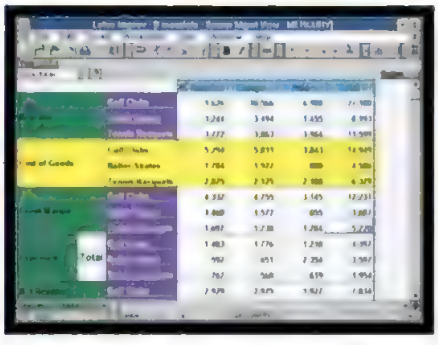

Drag and drop again for yet another view. You can save different views for future reference.

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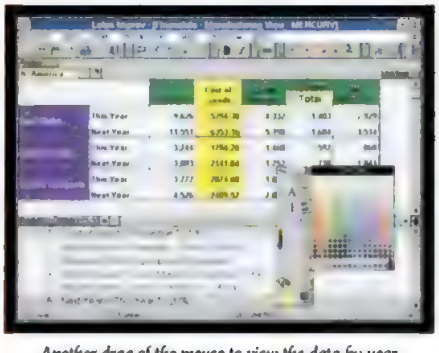

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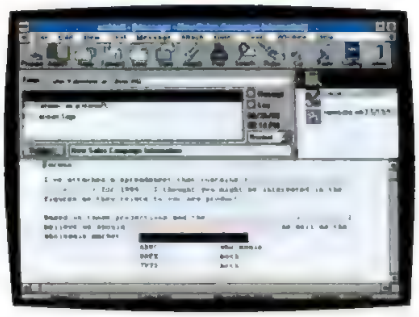

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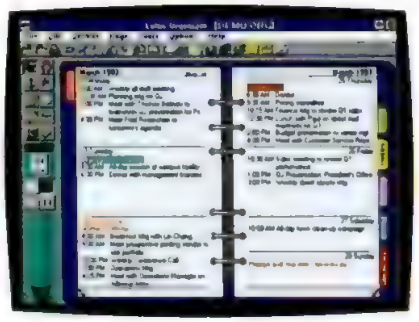

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Toolkits

REVIEWS OF THE LATEST TOOLS FOR THE PC PROGRAMMER

Edited by Rock Miller

Fortify Your Programs with Bounds-Checker for Windows

BY RICK KNOBLAUGH

C and C++ programmers who develop applications under Windows quickly become painfully aware of how subtle bugs can result from memory overwrites, resource and memory leaks, and the incorrect use of API function parameters. These bugs may manifest themselves in mysterious ways, in the worst cases going undetected and making their way into products that are shipping. But Nu-Mega Technologies' Bounds-Checker for Windows ($199) can save you from these potential nightmares; it's a fully automatic bug-uncovering solution that combines the features of a heap checker, debug kernel, and post-mortem tool.

Bounds-Checker (which requires a 386-based PC or better) does several things for you. It verifies your program's use of C-library functions that relate to string and memory manipulation. It checks all API call parameters. It watches for null pointer memory accesses. It tracks the allocation and freeing of memory and resources. It detects heap corruption. And it helps diagnose the underlying problems that cause processor exceptions. It can take advantage of the debug information you compile into your programs (both Borland and Microsoft formats are supported), and it uses its knowledge of Windows API calls to provide informative source-level displays when bug-laden instructions are executed within its scrutiny.

In fact, if you use Nu-Mega's Soft-ICE for Windows (Version 1.2 or later) as your debugger, Bounds-Checker gives you the option of transferring control to it when a bug is detected. This powerful combination lets you find problems and diagnose them by tracing instructions, setting breakpoints, and so on.

Impressively, Bounds-Checker does its work without requiring you to add any additional code to your application—no special macros or link libraries are necessary. Rather, it uses INT 3–style breakpoints to help it intercept library calls that involve the allocating, freeing, or writing of memory. In the case of memory writes, it uses its knowledge of data areas (gleaned from the debug information and monitoring of memory allocation calls) to verify that the operation will not overstep a memory block or program data area boundary. (For example, if you call the `strcpy` routine with a length that exceeds the size of the destination array, Bounds-Checker will pop up to show you the source line of the offending instruction). It detects null pointer accesses by using debug registers to trap memory writes to the first 16 bytes of the data segment.

To further guard against overruns of heap areas, Bounds-Checker writes an identifying signature after each allocated memory block, whose areas are inspected when the blocks are freed. Indeed, you can optionally configure Bounds-Checker in "Verbose Data Mode," in which it will check the heap blocks whenever library routines that manipulate buffers are executed. This slows performance but increases your chances of trapping an overrun closer to its point of inception. As it monitors your program's execution, Bounds-Checker generates a log file of any resources that it has allocated but not freed up. It also conveniently notes the program's actual stack usage, so you can reduce your stack allocation to precisely the amount the program really needs.

Bounds-Checker can do extensive API parameter checking without requiring a debug kernel. All API parameters are inspected for valid addresses, valid ranges, correct handles, and appropriate flags and bitmasks. When parameters are illegal, Bounds-Checker activates before the API call is issued. Since Bounds-Checker intervenes and alerts you to potential bugs, it's fitting that it should gain control when processor exceptions occur.

When your program generates a divide-by-zero error, or a general protection fault, Bounds-Checker can show you the instruction that caused the problem. And if the fault-inducing instruction was contained in a library for which no source code is available, Bounds-Checker will attempt to "walk the stack" to find its way back to the program source code line that initiated the call.

Bounds-Checker's intuitive, configurable interface does a good job of enhancing your debugging productivity. Code data, registers, call stack, status, and system information are displayed in separate windows; in the code window, you can toggle between source and unassembled code displays. When an error is detected, a status window shows its type, source line number, procedure, source file, and module in which it is contained. The screen makes excellent use of display colors to bring items such as API calls to your attention. When an API name is displayed, you can double-click on it to bring up the Windows SDK help file that details the correct usage.

Within the data window, you can choose among byte, word, ASCII, integer, and unsigned integer formats. Meanwhile, the information window shows your program's use of Windows handles, classes, global heap, local heap, symbols, and the system stack. These windows are very well integrated: Selecting a code or data item in another window causes the code or data window contents to be updated as well. And for added flexibility, most of the displaying and checking that Bounds-Checker performs can be configured either through menus or by editing the configuration files directly.

If you develop Windows applications using C/C++, add Bounds-Checker to your debugging toolkit: It will fortify your programs while shortening your debugging time. □

• Bounds-Checker for Windows, Version 1.0
List price: *$199; $499 bundled with Soft-ICE for Windows.*
Requires: *386SX-based PC or better, 4MB RAM, Microsoft Windows 3.1 (Enhanced mode required). Nu-Mega Technologies Inc., P.O. Box 7780, Nashua, NH 03060-7780; 603-889-2386; fax, 603-889-1135.*
Circle 451 on reader service card

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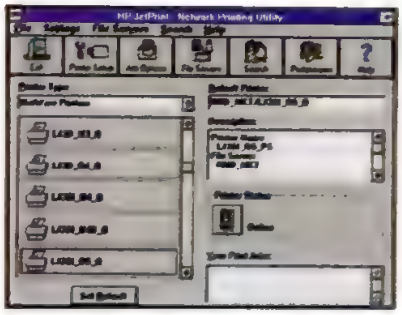

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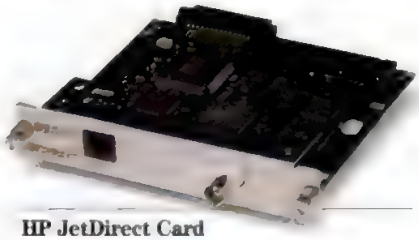

HP JetDirect Card

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CIRCLE 358 ON READER SERVICE CARD

Michael J. Miller

Stuck Inside Those Windows Blues

As much as I hate to admit it, I've become more convinced lately that the desktop operating system standard for the next 12 to 18 months will be . . . DOS and Windows 3.1. Still. It won't be OS/2, and it won't be Windows NT. Nor will it be any of the other 32-bit competitors—as attractive as all these alternatives may be.

COMPATIBILITY IS KEY

That's because I've become convinced that we've all understated the importance of compatibility. It's been clear for a long time that for an environment to work, we need great applications that work under it. It's also quite important that the mainstream desktop operating system be compatible with an extremely wide variety of hardware. That level of compatibility is where I think OS/2, NT, and all the other 32-bit options fall short.

One real issue here is device drivers. None of us run vanilla PCs anymore. We all have something that requires a special driver: a mouse, a sound board, a CD-ROM drive, some type of SCSI device, a nonstandard video board, or a network adapter. It all dates back to the introduction of DOS 2.0 in 1983, which added the feature that allowed for device drivers. Today, these drivers, whether loaded in our CONFIG.SYS files or our newer Windows .INI files, are just a fact of life in today's PC environment.

DRIVING DEVICES

Today, no one would ship a device requiring a device driver that wouldn't work with both DOS and Windows. The same cannot be said of OS/2 today; nor is it likely to be true of any of the other advanced operating systems in the near future. It simply takes time to get all these devices ready to ship with a tremendous amount of support for multiple operating systems.

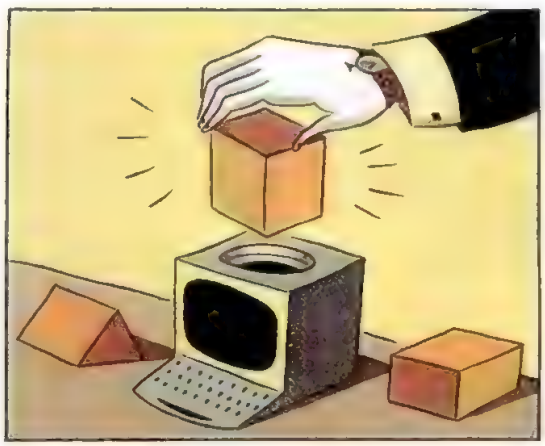
Look at OS/2 today. Version 2.1 already ships with far more device support than early versions of Windows did, and it's still not enough. In part that's because Windows could use the existing DOS devices; and in part, that's because we have more complicated systems today.

Consider what I went through getting OS/2 to work on one not particularly unusual machine: I wanted to install it from a CD-ROM, but I had a nonsupported SCSI device in the box, so it wouldn't work. Eventually, I was able to track down beta drivers, but that wasn't enough. I also discovered I would need beta video drivers to run my third-party video adapter in anything better than VGA mode; and special OS/2 device drivers to work with my network adapter. But before I can even try them, IBM said I have to upgrade the BIOS on my machine, because IBM doesn't support it. (This an older Dell 486—hardly a no-name machine.)

NOT YOUR AVERAGE END USER

While Microsoft has been better than IBM at getting out device-driver kits to hardware manufacturers earlier in the process, I expect NT will have at least as many problems as OS/2. After all, it's in its first release, while OS/2 has been on the market for some time. The other 32-bit operating systems face an even harder battle.

Now, I will put up with this—I'll take the time to track down the drivers or use slightly buggy or less than full-featured drivers, just because I want to use these advanced systems. But I don't expect the average end-user to do so.



Compatibility is where OS/2, NT, and all the other 32-bit options fall short.

WE NEED A NEW ONE

It really is a shame that DOS and Windows 3.1 will linger on. I started out the column by saying "I hate to admit it," and that's because we could use a new operating system standard. The only way that we'll ever see multiple software tools or objects in

Illustration by Michael Klein

use on the desktop simultaneously is if we have a real multi-tasking, multi-threaded operating system. Similarly, such an advanced OS will be necessary to make multimedia (particularly integrated motion video) commonplace; to allow information from multiple sources to be successfully integrated into the desktop continuously; or to really allow PC-based mission-critical applications. Also, we all could use a more secure, more robust operating system.

Still, all of these are hard to sell if they involve a significant trade-off in hardware or software compatibility. To many people, Windows 3.1 is good enough—in large part because it either comes installed on their systems, or they can load it on their computers easily. For something to replace or even to coexist with Windows as a standard on the PC desktop, it will have to be just as easy to install on the bulk of systems in the market.

This can happen, of course, but it won't happen overnight. As OS/2 is installed in more places, in more markets, IBM gets more experienced at providing the right level of hardware and software compatibility. At the same time, the third-party hardware and software vendors have more incentive to make sure their products will work in that environment.

KEY APPLICATIONS

The same would be true of NT. The key to success in both cases—and in the cases of other operating systems and, indeed, other hardware platforms—is to find some key applications and grow from there. In other words, OS/2 and NT need to show users key applications whose unique features are so compelling that the changeover would be worthwhile, even if the applications are not compatible enough for general desktop use. Possibilities include running an application server, providing additional power for design or engineering, or allowing multiple communications necessary in stock trading.

For the makers of these new platforms, the first step is to get them installed in these key new applications, so that real customers can see the benefits of 32-bit, multi-tasking, multi-threaded applications. From there, the OS vendors have to make customers want to see these platforms installed on more and more new machines, where it is easier to control compatibility. As the installed base grows, the device manufacturers will have more of an incentive to assure compatibility with the new operating systems, and IBM or Microsoft will have more time to get broader device support. In time, we may see enough support so these systems can attract the mass market of desktops. In other words, the new platforms must first find a niche or a series of niches, then grow from there into a broader role.

REAL BENEFITS

My guess is that all of this will take at least 12 to 18 months. By that point, we'll have new versions of all of these systems on, or nearing, the market—ranging from the Taligent frameworks on top of the IBM microkernel to the "Cairo" release of NT to the "Chicago" upgrade for Windows 3.1. All of these sound great on paper, but all they are today is slideware—marketing presentations. To make it on the desktop, they'll have to provide real benefits for typical end users, and still provide the level of compatibility that, for better or worse, customers expect. □

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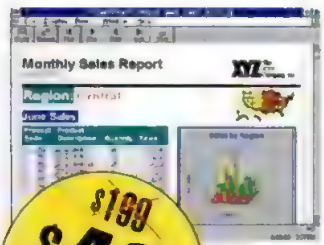

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New TI TravelMate™ 4000E WinDX2™/50 Active Matrix Color

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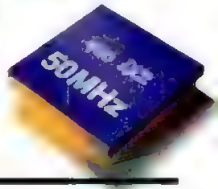

Of the leading active matrix color notebook manufacturers, only TI offers the desktop performance of a 50MHz DX2 processor.

Active Color Notebook	*Weight (lbs.)*	*486 Processor*	*Speed*	*Coprocessor*
TravelMate 4000E	**6.2**	**DX2**	**50MHz**	**Yes**
Toshiba T4600C	6.9	SL	33MHz	Yes
Compaq LTE Lite 4/33c	6.5	SL	33MHz	Yes
IBM ThinkPad 720C	7.6	SLC2	50MHz	No

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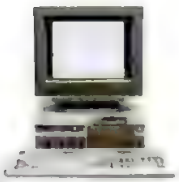
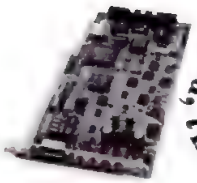


In desperation I asked my friend about turning my PC into a multimedia powerhouse. EASY he said. Just get the award-winning 16-bit stereo sound card,



the Pro AudioSpectrum™ 16. Sounds great I said. But he wasn't done. I also needed a double speed NEC CD-ROM drive for superfast performance, a pair of amplified speakers and

a bunch of really exciting software. Then for kickers he said that it all should be industry standard, state-of-the-art, fully compatible, and set up my computer automatically. So where the heck am I going to find all this in an affordable package?

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CIRCLE 093 ON READER SERVICE CARD

Bill Machrone

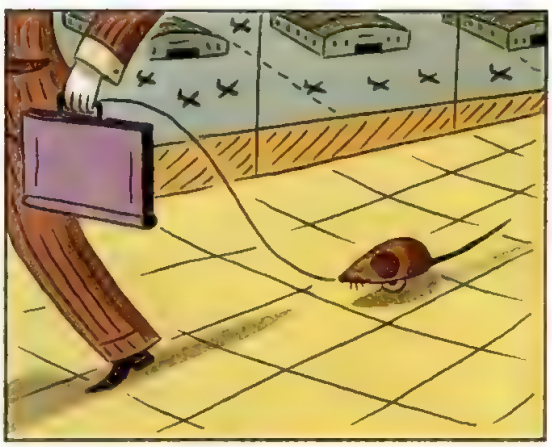
The Misunderstood Mouse

His name is Gulliver, and I like to think I had something to do with his creation. He's the latest offering from Appoint Corp., the manufacturers of the PenMouse and the popular Thumbelina trackball. At about 2 by 2 inches, Thumbelina is the smallest trackball available. It has a locking drag button, which makes it easy to use for those of us who have slightly less dexterity than a neurosurgeon or a riverboat gambler. My Gateway Nomad came with a Thumbelina, complete with a nearly unusable bracket that screwed into the side of the case after you removed a little cover that promptly disappeared forever. (The mark of a well-used Texas Instruments or Gateway notebook is the absence of the port and accessory covers—the equivalent of having pick marks on a favorite guitar.) I found myself either using Thumbelina without the bracket or packing along a desktop mouse. Of course, that desktop mouse was always too big and too bulky, and its cord was far too long.

From the first time I saw Thumbelina, I found myself wishing that I could turn it over and use it as a miniature mouse. I said so to the Appoint people and in these pages. Unfortunately, turning it over put the buttons on the bottom, well out of reach. Also, the hard Delrin ball was well suited for thumbs but fussy about the surfaces you could roll it on. (When I traveled with the PenMouse, which also used a Delrin ball, I used a Post-It note as a mouse pad on the airplane's tray table.) The folks at Appoint knew everything about Delrin ball technology, but little about the physics and mechanics of the rubber-coated roller needed to build more conventional mice. It was more than a normal learning curve, though, because they were also taking rubber-coated ball technology to new levels of miniaturization.

The result of much trial, error, and research was Gulliver. A diminutive pentagon with softly rounded sides, it can be grasped easily in either hand, and the entire nose is the left button. The right button is directly behind the nose, its shape, height, and higher spring tension providing strong tactile cues to your hand. Toward the back of the mouse is a small, triangular button. Click it once and you turn on an internal accelerator that doubles the rate of pulses from the mouse. Click it again and Gulliver reverts to slower, more precise movement. Thus you can have maximum motion in minimum space and extreme precision when you need it. The pulses, by the way, are called "Mickeys," and a driver converts them into the appropriate movements of your cursor.

The unit's standard Microsoft driver has a step function built into it, where a low rate of pulses from a slow-moving mouse is translated into smaller, more exact cursor movements than faster mouse movements. You can set the amount of acceleration either at the DOS prompt or in Windows. I leave Gulliver in high gear all the time, with a moderate amount of acceleration in the driver. I seldom have to move the mouse more than half an inch to perform necessary tasks. As I write this, I'm using it on the armrest of an airplane seat.



Portable pointing devices are still the province of personal preference. My own pick is a pint-size pentagon.

ULTIMATE POINTER

In Gulliver, Appoint is closing in on the ultimate portable pointing device. It has the requisite small size, comfortable ergonomics, and short cord. Ironically, Gulliver has been more popular to date for desktop use than for portable use. (It comes with an extension cord that easily reaches the machine under your desk.) I guess folks like its size and features and the fact that they can always take it with them on the road if they have the urge.

I've been using portable pointing devices ever since I crammed Windows

Illustration by Michael Klein

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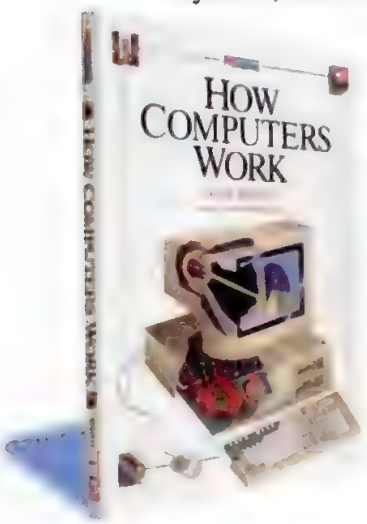

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onto a laptop, and they've been a very mixed bag. I've also used every kind of built-in pointing device, and as a group they're far from perfect, although the IBM-style pointing sticks work well for me.

All the little built-in trackballs are flawed in some way. Usually the buttons are poorly located, so dragging is a finger-bending feat. Compaq's cover-mounted trackball with the buttons on the other side of the cover is neat but tiring to use.

All the miniature trackballs suffer from the same malady: Dragging text is a hit-and-miss affair. A proper trackball's size and weight are akin to something that Minnesota Fats would be happy dropping into a side pocket. A tiny trackball has no appreciable mass or inertia, and the small radius makes it extremely difficult to move the cursor, say, from side to side without introducing unintentional movements up or down. Furthermore, once your cursor has wandered into forbidden territory, chances are excellent that you'll overshoot when you try to correct. Hands and arms, it turns out, are far more adept at isolating fore-and-aft movements from side-to-side movements than thumbs are.

This should come as no surprise; our world is full of demanding tasks of adroitness for our hands and fingers, while the biggest workout my thumb gets is in thumb wrestling with my 8-year-old. The opposed thumb is one of the defining characteristics of our species, and mine are strongly opposed to working pointing devices.

FUNDAMENTAL FLAW

It's easy to see why those diminutive trackballs are attractive to the manufacturers. The biggest problem with a mouse as the pointing device for a portable computer is the cord. You can't very well snap the machine shut and dash off to your next meeting with the mouse flailing in the breeze. If you unplug it, the machine is highly likely to forget that it had ever made the mouse's acquaintance—until you reboot. Hewlett-Packard Co. has an interesting solution in the mechanically tethered mouse on the HP OmniBook 300, which folds and slips into its own garage in the side of the machine. It works well enough but feels a little flimsy. I vote for wireless. An infrared or RF mouse would give you all the benefits with none of the drawbacks. Hey, Appoint! Are you listening? □

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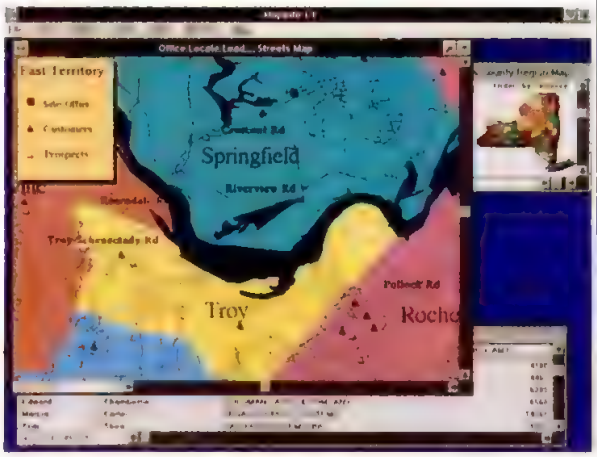

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CIRCLE 125 ON READER SERVICE CARD

John C. Dvorak

What I Did This Summer

The computer-trade-show circuit keeps me busy year-round, but this summer I discovered one heck of a good show. If you want to step out ahead of the trends and watch them come your way, you've got to haul yourself over to Taiwan for Computex. Those of us who frequent industry trade shows do so to keep up with trends and, maybe, get a glimpse of some hot new technology.

What you get out of Computex are ideas. You see the seeds of potential trends. If you can come away from a trade show with new ideas, then you've had valuable experience. But with most of the big trade shows today, there are no surprises as long as you've done your homework. When many of us go to Comdex, we already know what's going to be there. The trends are already established. Most large shows merely reflect and magnify existing trends.

With Computex, the opposite is true. Taiwan is as important a player in the small-computer industry as America and Japan. Japan is a leader in certain subsystems, such as floppy disk drives and CD-ROM players, and in laptop/notebook technology. America runs the CPU and hard disk show. Taiwan does nearly everything else, including cabinet design and manufacture, subnotebooks, motherboards, add-in cards, video cards, monitors, and more.

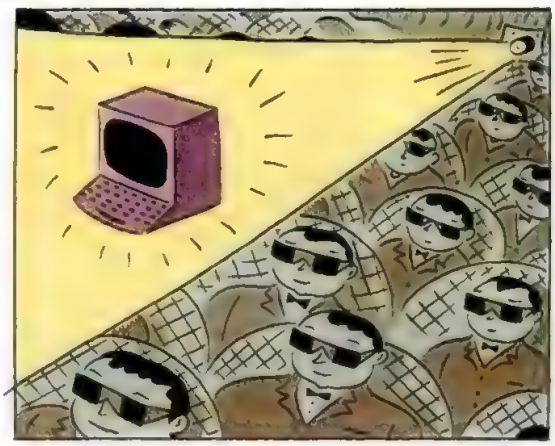
Computex is mainly for the trade; all business is oriented toward the wholesale buyer. It's designed so the parts buyer at Gateway 2000 can find a supplier for some part or other. If you need 5,000 10BaseT cards, I doubt you'll beat these prices.

I found the show quite educational. The best keyboard you can buy costs around $35. The typical mouse is $5. A nice full-size tower case might be $30. If there's a drawback to the show, it might be the yen you feel to start a clone-making business after only a few minutes of walking the floor.

Another great aspect of Computex, unlike anything at American shows, is the amazing experimentation going on at the vendor level. Almost all of the case makers, mouse makers, and computer packagers have gone over to color. We're talking about a line of machines available in dozens of colors. If this is the seed of a trend, then we'll finally have colorful computers instead of the same old beige. I even saw one outstanding grape-colored case, mouse, and keyboard.

When it came to raw creativity, there were dozens of palmtop machines, all seeking a partnership with someone for distribution in the U.S. and elsewhere. Notebooks were another big item. At least 20 new notebooks and subnotebooks were on display. Let me say here that one trend is clear: *All* these things will be well under 5 pounds. Also, there were at least five companies specializing in so-called "book-size" computers. If you remember the Cary-1, then you've seen this trend starting to emerge.

One big attraction at Computex is the chance to see what goes on at the wacky end of the experimentation spectrum. One guy was showing a VESA card with two parallel ports, two serial ports, and a joystick port. I guessed this was for people who wanted really responsive I/0. Oddball VESA cards were everywhere.

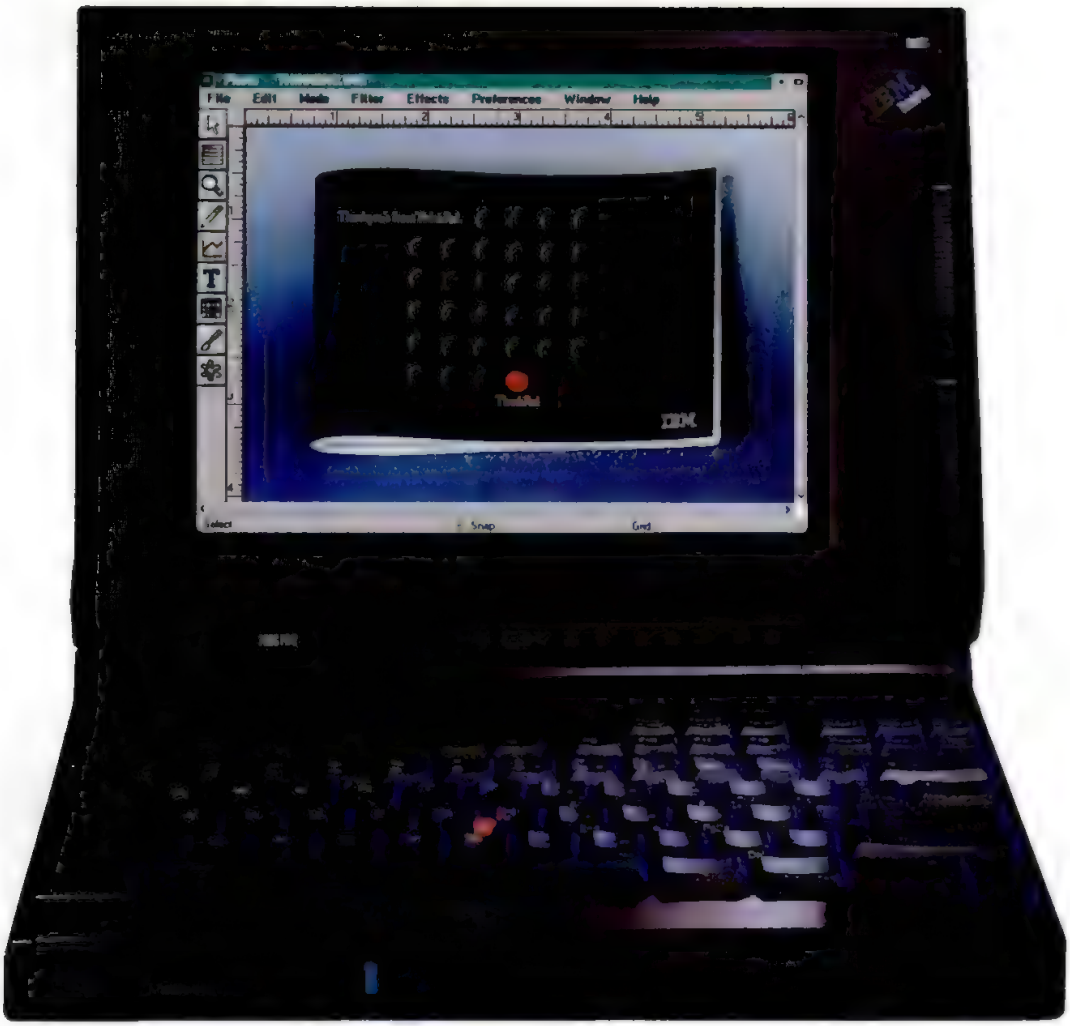


To discover the future and see the most unusual products, you've got to go to Taiwan for the Computex trade show.

Besides all the small Taiwanese firms, the American firms, such as Intel and Cyrix and Seagate, were all there talking about things they would never discuss at Comdex.

I highly recommend that you schedule Computex on your calendar. For more information, contact the China External Trade Development Council, the show promoters, in Taiwan, at 886-2-725-5200, or fax them at 886-2-757-6653.

Illustration by Michael Klein



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John C. Dvorak

Inside Track

They Weren't Kidding Dept.: Remember a technology known as **vertical recording** from a few years back? The idea was that if disk media could be recorded in an up-and-down plane (vertical) rather than across the media, then you could achieve **incredible densities.** Years went by. I forgot about this concept until Toshiba mentioned to me that the 2.44MB 3.5-inch floppy disk employs this technology. But this mere doubling of density isn't the end of it. On soft hygroscopic media, such as floppy disks, I suppose doubling is about all we can expect without using servo tracks as in the Floptical. You have to remember that floppy disks grow and shrink depending on humidity. Hard disks are where vertical recording will take us to new dimensions. Look for the heavyweights in hard disks to bring out **9-gigabyte hard disks** at Comdex in November. I suspect these might all be smallish 3.5-inch drives. I was told, "We got '9 gigabytes' running in the labs, and they seem to actually work!" That 250MB backup unit is going to seem **pretty puny,** huh?

Vertical recording technology will take hard disk storage to new dimensions. In the fall, look for the heavyweights in hard disks to debut 3.5-inch drives that hold a whopping 9GB.

RAID kills bugs dead! I talked to Micropolis about these upcoming monsters, and, in the process, the company gave me some insight on the true reason for RAID (Redundant Array of Inexpensive Disks). For obvious reasons (the word *inexpensive* comes to mind), I believed that RAID was a cheap way to get high capacity, when it's really designed as a methodology to create a **large virtual drive that's fail-safe.** RAID is designed so that a drive within the array can fail but **no data is lost.** It's that simple. "Do you really want to risk 9 gigabytes on one spindle?" I was asked. If you want to see the niftiest RAID device, Micropolis has a stunning modular unit designed by **Frog** Studios (the design team that did the early Mac design and other futurist devices). The drives can be effortlessly popped in and out to achieve various RAID levels. **Highly recommended** and beautiful, too!

One-spindle gambling or not, Micropolis is also the company to watch for these high-capacity drives. I expect Micropolis to be leading the way in the **9-gigabyte derby.** Meanwhile, it's shipping an **incredible 1.2-gigabyte IDE drive** (don't let anyone tell you that you can't run more than 500 megabytes over IDE). This fast drive measures about the size of a 3.5-inch floppy disk drive and weighs almost nothing. It's **stunning** and faster than the company's own SCSI gigabyte drive. IDE's low overhead means it will beat SCSI in any drag race.

IDE Is King. Long Live ATA Dept.: Look for more big IDE drives, IDE CD-ROMs (Gateway 2000 will begin to use them exclusively), as well as IDE-compatible backup tape drives (Summit, for starters). IDE is the clear winner on the workstation, and now the IDE promoters led by Western Digital will be coming out with a **new IDE specification** that will allow even more devices to run under IDE. Currently, according to research, 95 percent of all disk drives on PCs are IDE. I mention this because, as IDE takes over the I/O subsystem, the IDE promoters want to change the name to ATA! Talk about **marketing fiascos.** ATA means AT (as in PC/AT—how quaint) Attachable. The promoters believe this is a better term for the future than IDE, which means either *integrated drive electronics* or *intelligent drive electronics* (or *integrated development environment*), depending on whom you ask. For now, I'm seeing the term IDE/ATA as a transition term.

The always-a-bridesmaid-never-a-bride interface will remain SCSI in the PC arena and be used mostly in server applications where multitasking the drive subsystem might pay off. Look at the Future Domain PowerSCSI subsystem and the Adaptec SCSIExpress for systems that try to be all things to all machines.

Genuinely Interesting SoftWEAR Dept.: If you want to get that computer-user friend a perfect gift (start thinking toward the holidays), look no further than an imaginative little company located in Richmond, California, called Iconz. This outfit offers a line of tasteful and **unique** hats, sweatshirts, mugs, and more. For example, it offers 100 percent wool baseball caps with computer-related logos. One cap displays a large C: prompt and says "DOS Power User." It's embroidered and **looks terrific.** My favorite is an off-white hat with a blue brim and an embroidered **bomb** logo (fuse-lit), a stylized version of the Mac system-error icon. The kids in my house have actually fought over that hat. It's $10. How about an Izod-like shirt with an embroidered floppy disk or C: prompt where the alligator would normally be found? Stuff like that. All very cool and very unique. The best I've seen, in fact. Call Iconz at 510-524-9200, or fax 510-528-9331 and ask for the catalog. Do yourself a favor and **order a bomb hat** while you're at it. □

If managing your server eats up all

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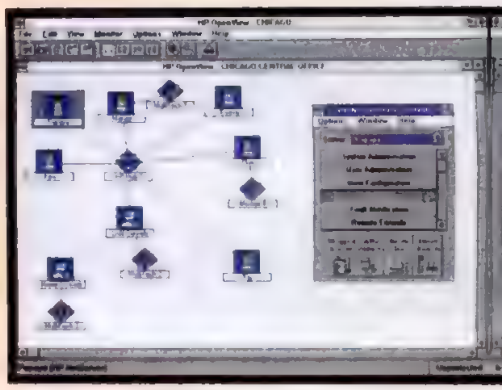

HP NetServer Assistant

HP NetServer LM

your time, you need an assistant.

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- 60-MHz Intel Pentium™ processor, 33-MHz Intel 486 DX and 66-MHz Intel 486 DX2 processors
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- 16-MB standard RAM, 384-MB maximum memory, ECC memory support
- 128-KB and 256-KB external cache
- 9 mass storage shelves, 3.5" floppy disk drive standard, maximum 8-GB internal storage
- 8 EISA-2 with Enhanced Master Burst bus-master I/O slots
- Integrated Fast SCSI-2, IDE and video controllers
- HP NetServer Assistant software included
- 3-year on-site, next-business-day limited warranty
- Tested and certified on major network operating systems

HP NetServer LE

$2,649**

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- Upgradable to Intel OverDrive Pentium technology-based processor when available
- 4-MB and 8-MB standard RAM, 128-MB maximum memory
- 256-KB external cache
- 4 mass storage shelves, 3.5" floppy disk drive standard, maximum 3-GB internal storage
- 5 EISA bus-master I/O slots
- Integrated Fast SCSI-2, IDE and video controllers
- HP NetServer Assistant software available as an option
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- Tested and certified on major network operating systems

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*U.S. list price for HP NetServer LM Model 530, including 486/33DX processor, 16-MB RAM and 535-MB SCSI hard drive. **U.S. list price for HP NetServer LE Model 240, including 486/33SX processor, 4-MB RAM and 240-MB IDE hard drive. Prices subject to change without notice. Pentium and the Intel Inside logo are U.S. trademarks of Intel Corporation. ©1993 Hewlett Packard Company. PPG686

HP NetServer LE

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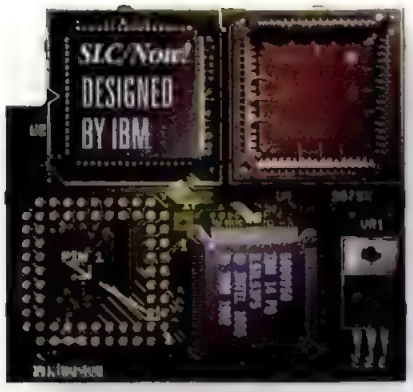

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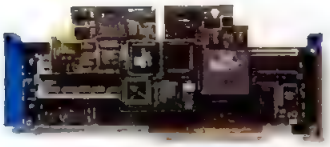

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Recount:	5:44 Min.	1:51 Min.	1:54 Min.	
Retail Price:		$215	$1,545	
SLC/Now!	**PS/2 Model 50**	**With SLC/Now! 50**	**PS/2 Model 90-0H9**	**SLC/Now!**
Landmark Speed 2.0:	13 MHz	114 MHz	84 MHz	IBM PS/2 Models 50, 50Z and 60
Recount:	3:34 Min.	:29 Sec.	:38 Sec.	
Retail Price:		$425	$3,280	
486/Now!	**PS/2 Model 70-25MHz**	**With 486/Now! SX 25**	**PS/2 Model 90-0H9**	**486/Now!**
Landmark Speed 2.0:	39 MHz	84 MHz	84 MHz	IBM PS/2 Models 70 and 80, Compaq Deskpro Models 386/16, 386/20, 386/20e, 386/25, 386/25e, 386/33
Recount:	:55 Sec.	:39 Sec.	:38 Sec.	
Retail Price:		$495	$3,280	
MCMaster	**PS/2 Model 55SX**	**With MCMaster SX 25**	**PS/2 Model 90-0H9**	**MCMaster**
Landmark Speed 2.0:	16 MHz	84 MHz	84 MHz	IBM PS/2 Models 55, 56, 57, 65, 70, 80 and 90
Recount:	2:47 Min.	:36 Sec.	:38 Sec.	
Retail Price:		$795	$3,280	

All systems tested with 16MB installed except MCMaster tested with 8MB on-board and 8MB on mother board. All system prices are MSRP at standard configuration as of 4/1/93. Processor upgrade prices are MSRP as of 4/1/93. Recount conducted on SMB Excel for Windows spreadsheet generated by Kingston Technology.

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CIRCLE 921 ON READER SERVICE CARD

Jim Seymour

On The Road Again

Well, it didn't turn out the way I thought it would: I underestimated the rate of progress in the PC business. Last November, I described an ongoing...ummm...*discussion* I'd been having with my wife about my efforts to find a truly portable PC to travel with ("How Bad A PC Can You Live With?" *PC Magazine*, November 24, 1992).

I'd show her one subnotebook after another, raving over its potential. She would take a look at the display, try typing on the keyboard, and then give it back, muttering, "C'mon, Jim. You can't *do* anything with this."

Sadly, she was right; the machines that were easiest to travel with were hardest to work with. I always wound up coming back to larger, heavier notebooks, in the 6- to 7-pound range, despite their weight and bulk.

So I wrote that I was going to try three machines for the next several months and then let users know which ones were best for me.

The units I chose were a 286-level Gateway 2000 Handbook and two 386SLs: a 386SL-based Dell 320SLi, from Dell Computer Corp, and a TI TravelMate 4000. I was also using a Macintosh PowerBook Duo, from Apple Computer, especially on trips to see clients with large installed bases of Macs.

The winner? None of the above.

I quickly abandoned the Handbook. It can't run Windows, and I live in Windows most of the time now. Even if I still relied on DOS apps, I wouldn't have stayed with the Handbook: It's okay for checking e-mail but too shy on computing power for much else.

The Dell 320SLi also fell by the wayside early on. Its dim, nonbacklit screen wore me down. In every other way it was a winner, but I hated squinting all the time.

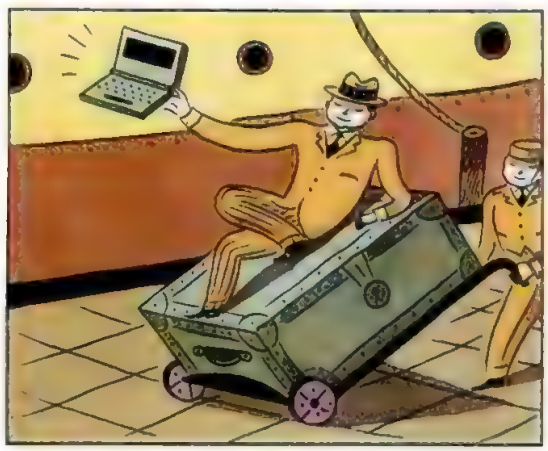
There was absolutely nothing wrong with the TravelMate or the PowerBook. But two new entries pushed both out of the ring for me.

One was the IBM ThinkPad 700C, about the same size and weight as the TravelMate but with a huge, brilliant color display, a bigger hard disk, more processing power, and a wonderful pointing device, the IBM PS/2 Trackpoint. You've no doubt read lots about the 700C by now; I won't bore you with the details. It is, simply put, the best full-size notebook PC I've used.

IBM has since replaced the 700C with the IBM ThinkPad 720C, which corrects one of four problems by adding two PCMCIA slots, inexplicably absent in the 700C. The unsolved problems? At more than 7 pounds, nearly the size and weight of a ream of paper, both are just too heavy to carry, unless I know I'm in for Serious Computing. That size and weight are aggravated by the lack of a proper handle; I've nearly dropped my 700C several times.

Unfortunately, the 720C doesn't fix any such problems. It and its predecessor are great units, but they're not by any stretch of the imagination carry-me-everywhere boxes.

The other new one is now a nearly constant companion. The HP OmniBook 300, from Hewlett Packard Co., has the best combination of size, weight, and functionality I've ever seen, coming closest to the "compute anywhere" goal I've been pursuing. I feel safe saying it will be 1993's Computer of the Year—even with Fall Comdex's introductions still to come.



"Lightweight! Works great!" So might go the cheer for our traveling columnist's favorite subnotebook.

You've probably read a lot about the OmniBook, as it's been out since early summer. I used mine several months before the announcement but waited to write about it till I was sure it was really as good as it first seemed.

It is.

At 6 by 11 by 1.5 inches (HWD) and a shade under 3 pounds, it's light and small enough to carry any-

Illustration by Michael Klein

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MONDO MONITOR®

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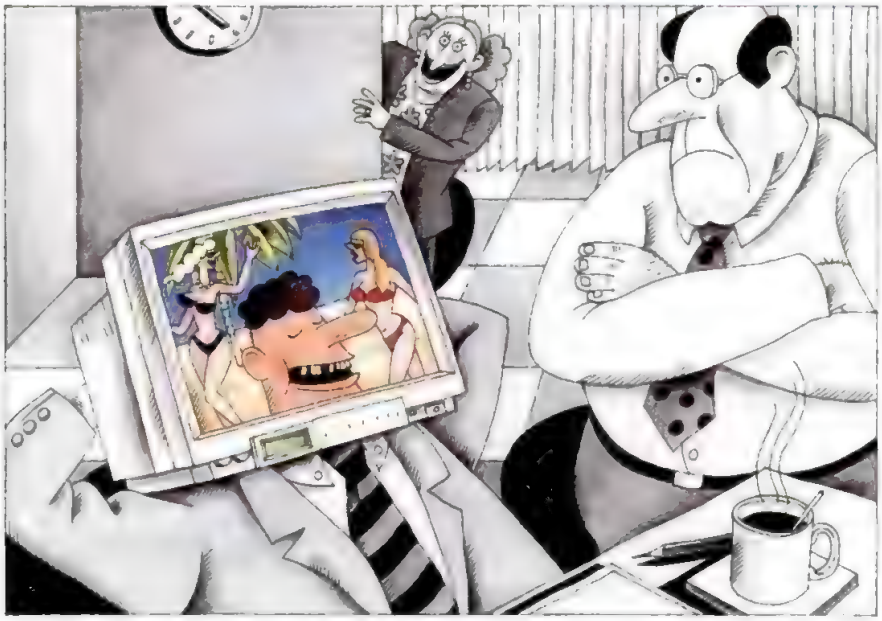

Obviously, Delmer just couldn't help daydreaming about his weekend spent in Cabo San Lucas. Careful, Delmer, Mr. Harkins is right behind you.

(The incredibly colorful images on Delmer's MAG MX17F monitor head would later prompt Mr. Harkins to book a weekend for himself.)

WIN A MAG MX15F MONITOR. SEND YOUR CARTOON IDEAS WITH RETURN ADDRESS AND TELEPHONE NUMBER TO MAG INNOVISION AT 2801 SOUTH YALE STREET, SANTA ANA, CA 92704, 800-827-3998, 714-751-2008 (IN CA), FAX: 714-751-5522. IF YOUR ENTRY IS SELECTED, YOU WILL RECEIVE A MAG MX15F MONITOR. ALL IDEAS SUBMITTED BECOME THE PROPERTY OF MAG INNOVISION.

CIRCLE 273 ON READER SERVICE CARD

where. (Yes, it could be thinner and lighter and no doubt someday will be; but I don't want it smaller, because I don't want a smaller screen or keyboard.)

The keyboard is very good. A pop-out mouse is clever and useful, almost as good as the PowerBook's built-in trackball, though taking up much less space. You can get either a 40MB mini-hard disk or a 10MB flash card for storage, both of which can be almost doubled in capacity with the special version of Microsoft DoubleSpace in ROM. Spend the extra $300 for the flash card; its lightning speed and no-moving-parts ruggedness are worth the price.

The OmniBook's display, while not backlit, is sensational. When I first got my hands on an OmniBook, I took one look at the screen, sneered, "Not backlit," and snapped the lid shut. I was a victim of my own prejudices: A notebook with no backlit screen simply couldn't be taken seriously.

Boy, was I wrong. Working with the machine for a few hours turned me around. I'm still amazed by the readability of type on that display. In any light I'm likely to be working in, it's sharp and contrasty, easy to see. I know this sounds facetious, but I find backlit screens glary now.

All that said, and my admiration for the machine notwithstanding, it's not for everyone. And it has flaws.

The problems? The machine comes with too little memory, and memory expansion, though easy via memory cards, is expensive. And transferring files back and forth between the OmniBook and your PC is a pain—for now. The OmniBook has a built-in infrared file-transfer system, including LapLink in ROM. But you can't yet buy an IR receiver for your desktop, so you have to fall back on LapLink transfers. That's fine for occasional transfers but a pain in the neck for daily exchanges.

OmniBook-compatible IR add-ons for desktops should be announced by the time you read this. Buy an add-on; you'll go nuts using cable transfers.

I don't carry an OmniBook on errands or social occasions, but I do carry it almost everywhere else. The PowerBook gained incredible cachet almost overnight for that kind of "totability," but if this is a just world, the OmniBook will quickly overtake the PowerBook as the truly hip walk-around computer of choice.

It has for me. □

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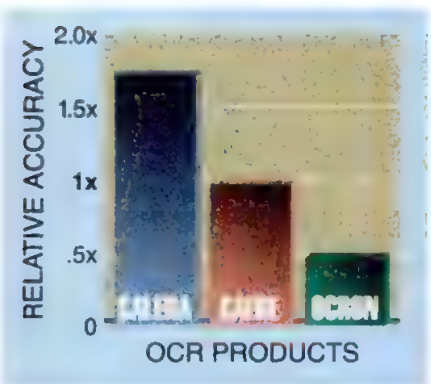

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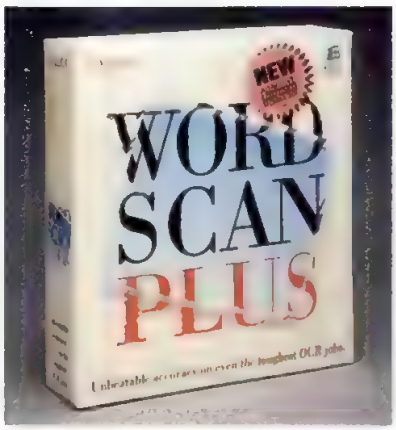

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CIRCLE 341 ON READER SERVICE CARD

THIS SHOULD GIVE YOU
OF WHY WE CREATED AN

The image you see over there started out attached to the image you see over here. But as it made its way to the printer, the computer it was created on recognized a problem: 11 x 17 pages can't fit on 8½ x 11 paper.

And so, out came the electronic scissors.

Now, if you're like a lot of people, you know all about this routine. And you know how it feels to walk into a meeting with a presention that contains hours of blood, sweat and tears, and a big fat strip of tape going right down the middle of it. Enough said.

COMPAQ PAGEMARQ Network Laser printers were built to help put an end to all of that. They can print 11 x 17 pages in a single pass. They come with up to three paper

trays, which lets you switch between paper sizes without leaving your desk, so you don't have to pull one paper tray out and replace it with another, only to have your neighbor

CONNECTIVITY OPTIONS

COMPAQ PAGEMARQ Printers can be directly connected into the following environments NetWare, EtherTalk, LocalTalk, LAN Manager, LAN Server, Windows NT, and TCP/IP (including Sun, HP, SCO, IBM, DEC and lpd compatible hosts)

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I A PRETTY GOOD IDEA
J 11 x 17 LASER PRINTER.

repeat the process two minutes later. They hold up to 1,500 sheets of paper. And for people whose design ambitions extend beyond Helvetica

Bold, PAGEMARQ Printers offer two ways to expand your type library, eliminating the need to continually download from your computer. You can add 1- and 2-MB Programmable Font Modules, or you can add an internal 60-MB Hard Drive.

All of which print with razor-sharp clarity thanks to the 800 x 400 dpi-high-resolution mode.

Of course, both the COMPAQ PAGEMARQ Laser Printers are fully backed by CompaqCare, our extensive service and support program. Which includes a one-year, on-site* limited warranty as well as unlimited toll-free telephone support. All at no additional charge whatsoever.

If you're interested in learning more, just call us at 1-800-345-1518 in either the U.S. or Canada.

We'll show you how to keep big ideas in one piece. At least until your client sees them. **COMPAQ**

A typographer's dream, these printers can store 1,500 fonts. Of course, not all of us dream about type. In which case, the 35 fonts that come standard are more than adequate

Add an Internal FAX Modem and you can turn your PC into a personal fax machine. One that will send and receive true Adobe PostScript quality faxes in any size up to 11 x 17

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CIRCLE 062 ON READER SERVICE CARD

Bill Howard

PC Vendor Out of Business?

What happens if your PC vendor goes belly-up? Can you get parts and service if your PC fails? If the unit is under warranty, will somebody pay for the service? These questions have been on the minds of more than a few PC buyers this year because of the recent vendor shakeout.

Vendor upheaval has *always* been a part of the PC business. Remember Columbia, Eagle, Kaypro, and Wells American? In the past year they've been joined in CPU heaven by Centrix, CompuSys, Data Hut, Fast Micro, Gecco, LodeStar, Micro Tough, Naga Systems, Penguin, and Standard. When Compaq fired the first shots of the Great PC Price War back in June 1992, it accelerated the demise of third-tier vendors that couldn't cut prices enough to sustain sales.

If you own a PC from a vendor that's now out of business, there's good news and bad news. You can get a broken PC working, almost without exception. But you may have to foot the bill.

Who pays for repairs? Responsibility for warranty service and repairs generally falls to the manufacturer, though some stores and dealers provide warranties. Warranty service is usually performed by independent service companies. Most PC vendors reimburse them on a monthly basis. Payments stop, of course, if the vendors go bust. Conscientious manufacturers underwrite the warranty, and the most responsible ones have a third party hold the money.

Can you get it repaired? There's very little inside a desktop PC that's available only from a single vendor. Even if the motherboard is proprietary, you can replace it with a functional equivalent for $250.

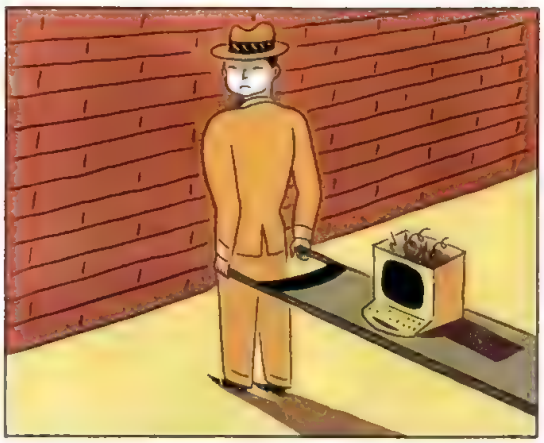
With laptops, it's a different story. Few parts are common. If your laptop breaks and your vendor is gone, you may have to look for a new laptop.

Who winds up with the leftover parts from the warehouse if the vendor goes away? Often, the vendor's service provider may buy up the unique parts, so that's the first place you should look for help.

Who to turn to. Dealers, component suppliers, and service providers may all disclaim legal responsibility for helping you out (they're usually correct), but some may feel an obligation to help in some way. One of the best examples: If you bought a PC with a Conner Peripherals hard drive from a now-defunct PC vendor, Conner says it will repair or replace the drive if the PC vendor's system warranty is still in effect. And sometimes a seemingly defunct vendor isn't really gone. For example, Occidental Systems, a Zeos International spin-off, was reabsorbed by Zeos, which now fulfills Occidental's warranty obligations.

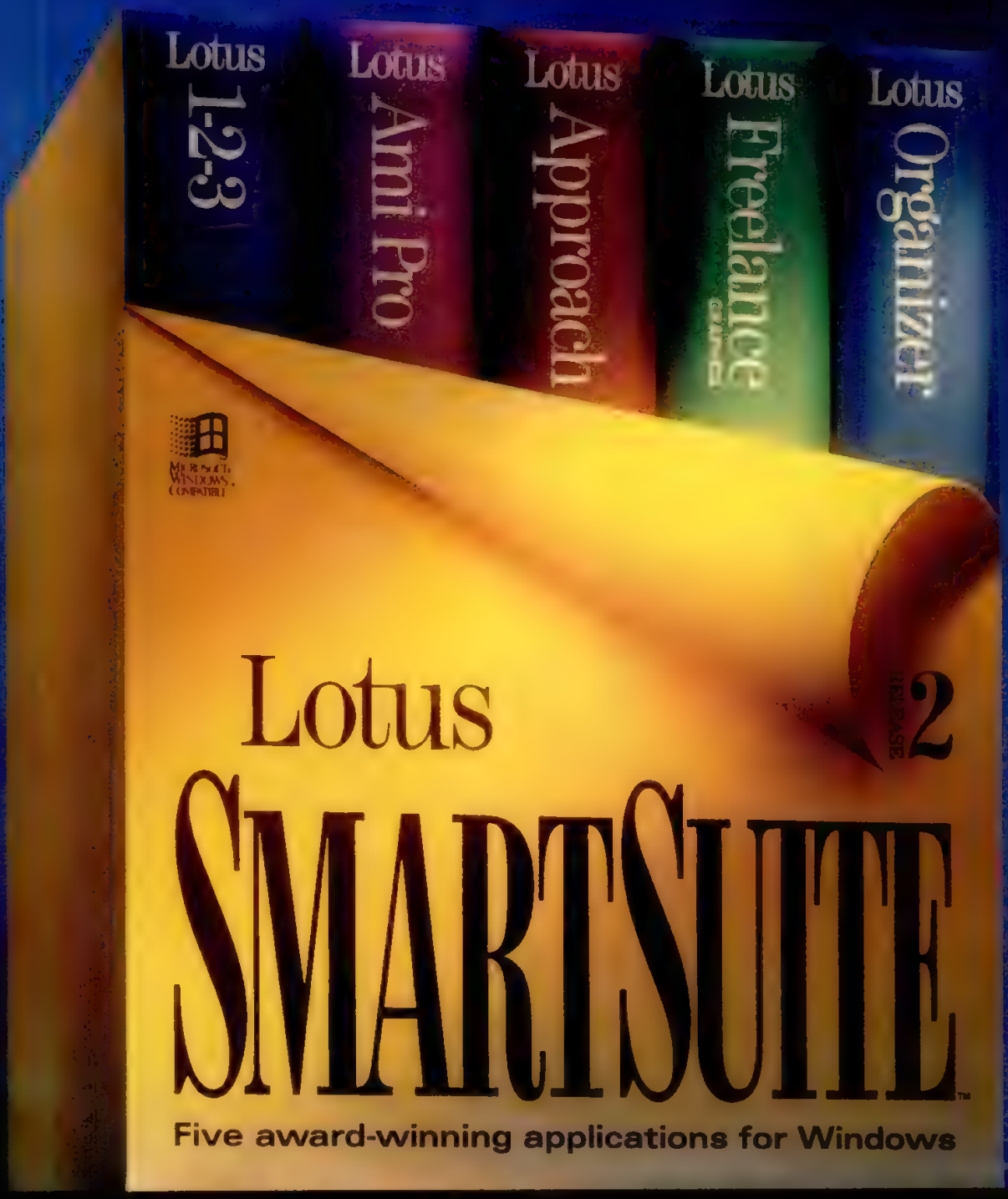
The forums on CompuServe are a great source of parts-and-service information about all vendors, living and dead, as well as setup and fine-tuning advice. Try IBM Hardware (GO IBMHW) or PC MagNet (GO PCMAG). Also try user groups in your area. If you must pay for repairs, carry-in is cheaper than paying $200-plus for an on-site service call.

Once bitten, twice shy? What about next time? Grill the vendor on who guarantees warranty service; then grill that guarantor. Look for vendors that were highly rated on *PC Magazine*'s "Service & Reliability" survey (July 1993), especially those with a high score on the would-you-buy-again question. Individual buyers should pay with a credit card. Corporate purchasers should run a credit check on the vendor and pay only after the equipment is delivered. Compaq would love it if you decided that the marketplace is so scary you don't want to buy from anyone but the top five vendors. With precautions, you can cast your net far wider. □



There's good news and bad news. You can get a broken PC working, but you may have to foot the bill.

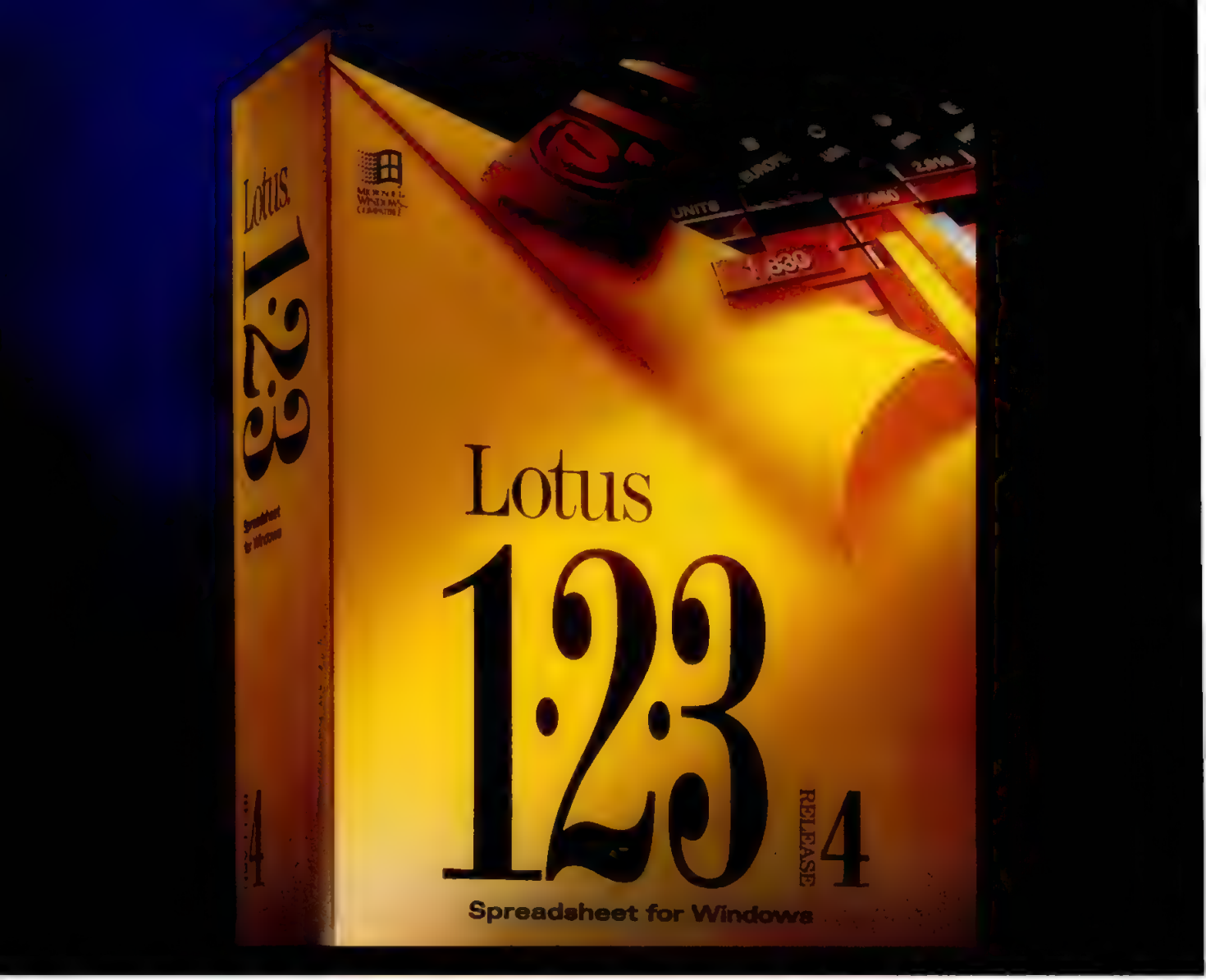
Illustration by Michael Klein



TO WINDOWS USERS, IT'S A "BUNDLE OF JOY."

– PC Letter 6/7/93

(TO MICROSOFT, IT'S PANDORA'S BOX)

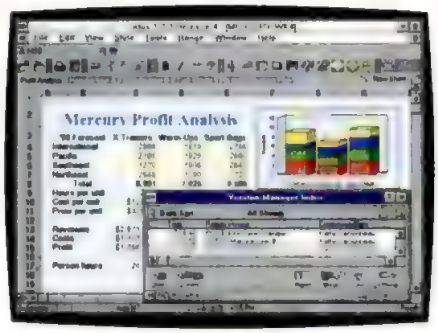


Thousands of DOS users who wouldn't move to Windows™ for Microsoft® Excel are jumping for Lotus® 1-2-3® Release 4. As are many who already use Windows.

And they're getting a spreadsheet that's not only much easier for them to use, but a lot more powerful in a lot of ways.

The new 1-2-3 is the first spreadsheet designed to help people work the way they want to work. Which is often together.

A raft of powerful new usability features makes 1-2-3 easy to learn and a pleasure to use. These include a context-sensitive user interface. A Live Status Bar. In-Cell™ Editing.



One-step charting. A completely new graphical interface for database queries. And Worksheet Tabs for 3D spreadsheets that make labeling and manipulating the work much easier.

The close integration of 1-2-3 with other Lotus Windows desktop applications lets you easily transfer 1-2-3 information, formats and processes to other applications where you need them. But it's the Version Manager, and other Working Together® features, that turn the 1-2-3 spreadsheet into a potent workgroup tool by letting people share and track information in new ways.

See for yourself. Visit your Lotus Authorized Reseller or call **1-800-TRADEUP, ext. 9420*** to upgrade for just $119 direct from Lotus. Or ask for a free demo disk. But first, turn the page and let's talk word processors.

Lotus
Working Together

*In Canada, call **1-800-GO-LOTUS**. ©1993 Lotus Development Corporation, 55 Cambridge Parkway, Cambridge, MA 02142. All rights reserved. Lotus, 1-2-3 and Working Together

"The SmartIcons in 1-2-3 for Windows are smarter and Lotus's approach to swapping different tool-bars in and out beats Excel's and Quattro Pro's."

PC/Computing 6/93

"1-2-3 LEAPFROGS EXCEL AND QUATTRO"

"Lotus's version manager blows away similar features in Excel and Quattro Pro."

Walter S. Mossberg
Wall Street Journal 7/29/93

–*PC World* 6/93

"Users who often collaborate on developing and refining worksheet data...will find Release 4 indispensable."

PC Week 5/3/93

"1-2-3 for Windows has always had more powerful database features than Excel or Quattro Pro and now these features are also easier to use."

BYTE 6/93

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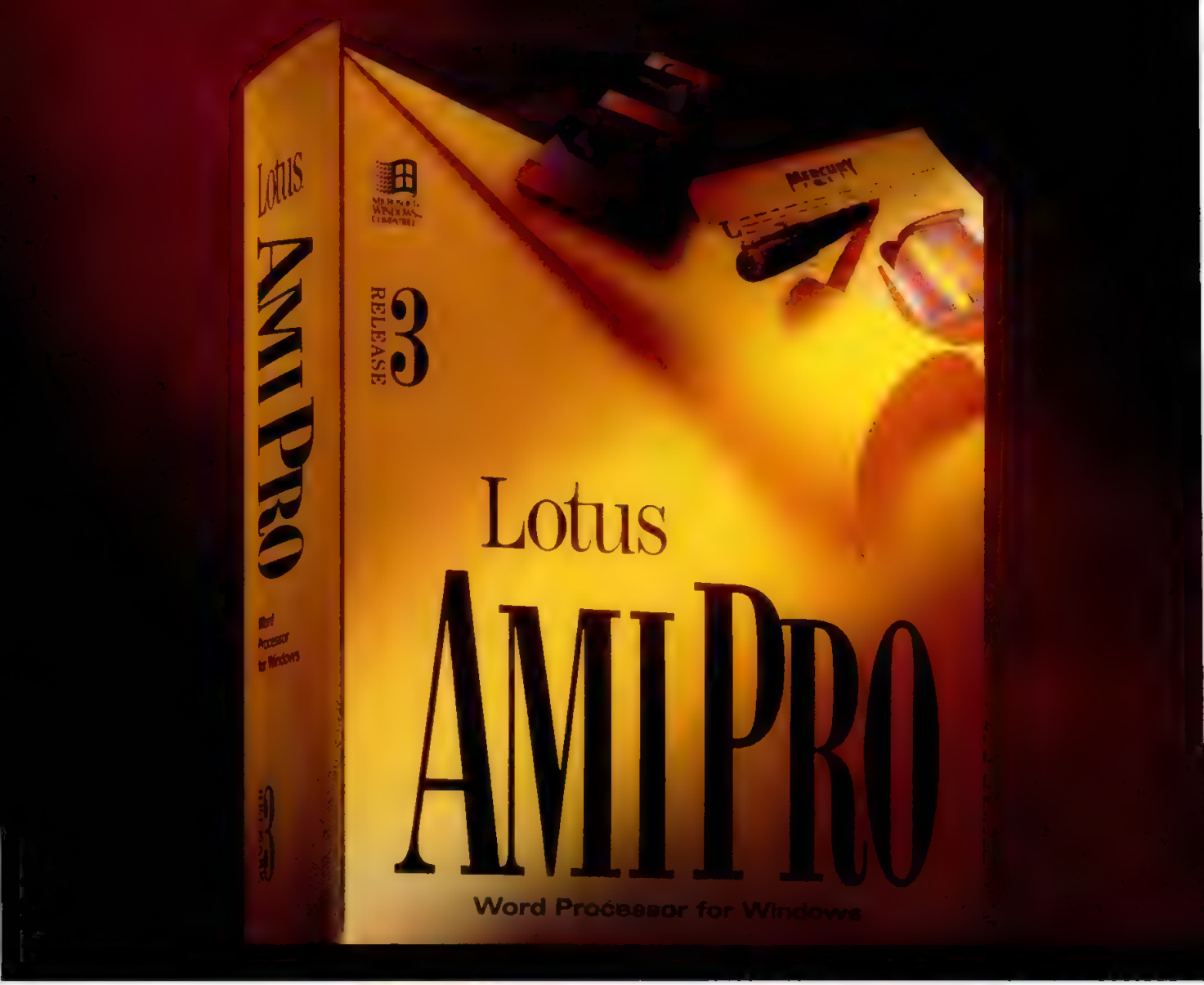
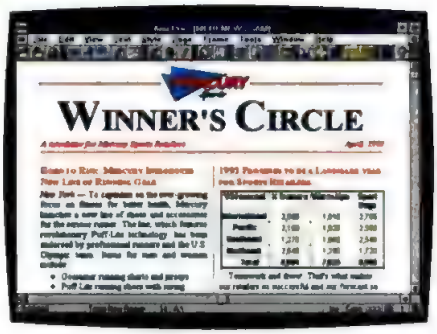


Software reviewers and industry experts have convincingly and consistently chosen Lotus® Ami Pro® as the best word processor over both Microsoft® Word and WordPerfect® for Windows.™

Again, in the August 1993 *PC/Computing Face-Off*, Ami Pro soundly beat Word, and swept both DOS and Windows versions of WordPerfect in 8 out of 8 categories.

If you're in the least nervous about leaving WordPerfect, or think Word is the easiest way to face Windows, Ami Pro will feel like a breath of fresh air. Because no one comes close to Ami Pro for making even the most complex



documents fast and easy. Using customizable, editable SmartIcons® that give you one-click access to most tasks, and a SwitchKit that takes any trauma out of leaving WordPerfect, you'll understand why new Ami Pro users rarely bother to open the manual.

Then consider the advantages of Ami Pro's tight integration with 1-2-3® and the other Lotus applications. With Ami Pro, you can not only exchange data, charts and functions with the other applications in a click, you can easily create hot links between applications.

Enough words. Visit your Lotus Authorized Reseller or call **1-800-TRADEUP, ext. 9420*** to order. Or ask for your free, full featured working model. Meanwhile, how happy are you with your presentation graphics software?

Lotus
Working Together

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"AMI PRO 3.0 TAKES THE LEAD OVER MICROSOFT WORD AS THE WINDOWS WORD PROCESSOR TO BEAT"

– *InfoWorld* 9/28/92

"Ami Pro 3.0 comes close to being perfect...It stands above Word and WordPerfect in both its function and in its speed."
Home Office Computing 1/93

"You can learn to use Ami Pro, the Lotus word processing program for Windows, in about a day. Put the manual in a drawer as a first step."
Forbes 2/1/93

"Usability, features, and performance – Ami Pro is the overall winner."
PC/Computing 8/93

"Users moving to Windows from DOS can fearlessly choose the latest Ami Pro Version."
PC World 3/93

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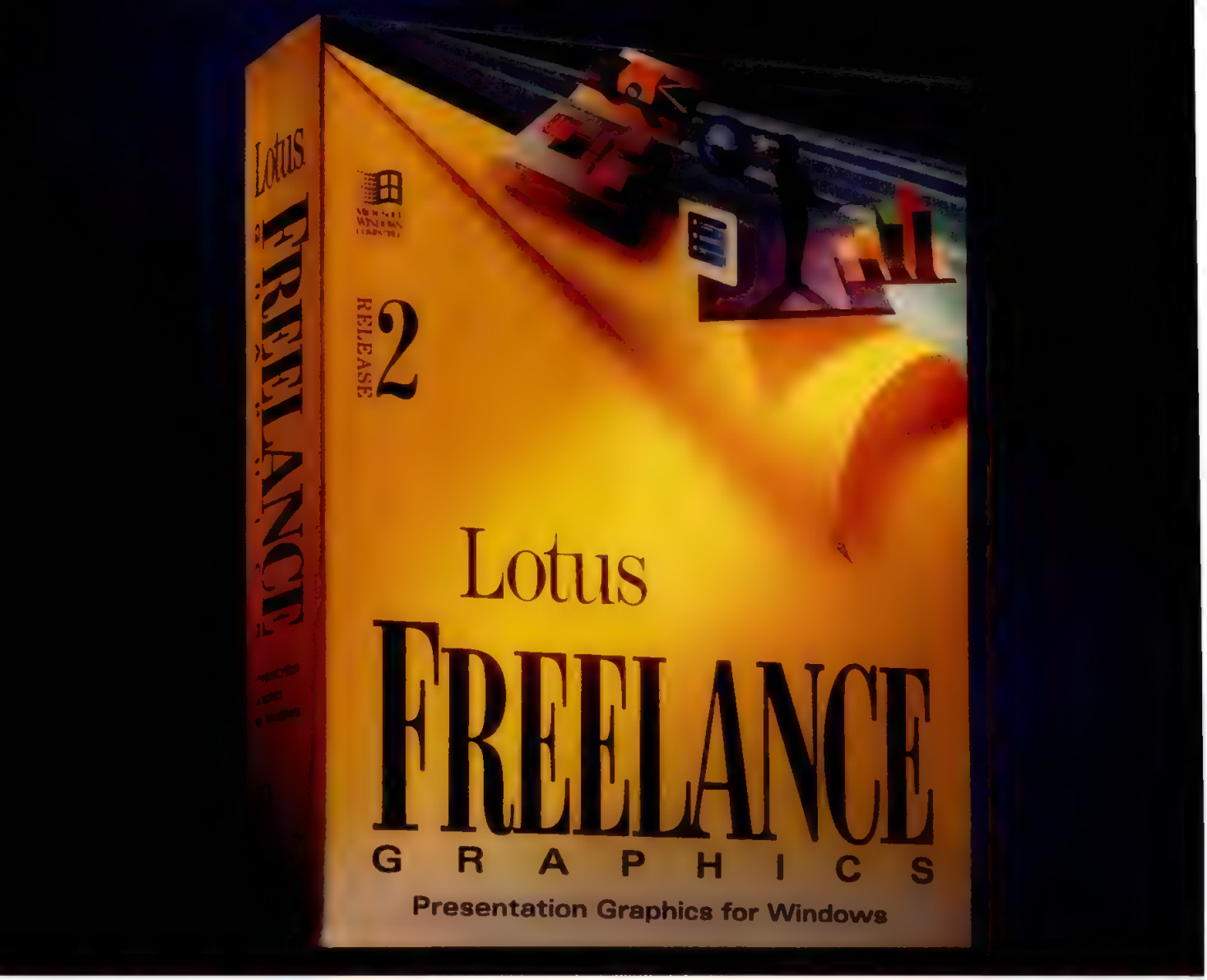
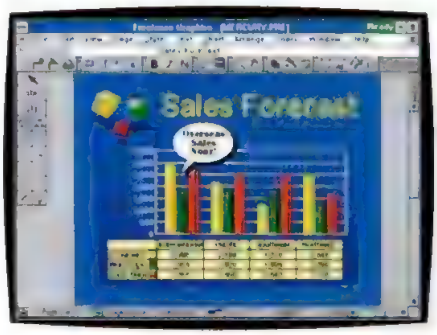


Year after year, Lotus® Freelance Graphics® has dominated both Harvard Graphics® and PowerPoint® in industry awards. This year, Freelance Graphics 2.01 has again set new standards, winning top ratings from InfoWorld, PC/Computing, BYTE and Windows Sources.

Historically, building professional looking presentations, even with the best software, has been time-consuming work. But with Freelance Graphics 2.01, it's so simple and so fast that people are now punching out charts for small presentations and even for hand-outs used at informal meetings.

One click is all it takes to access some of the most powerful features in Freelance



Graphics, like more than 65 SmartMaster™ design sets, 500 symbols and 100 chart styles. And when you're done, you can turn four-color overheads into black and white hand-outs with just one click.

The integration of Freelance Graphics with other Lotus applications is so complete that if you bring your 1-2-3® data into a Freelance presentation, and you later change a number in your 1-2-3 spreadsheet, it will be instantly reflected on the Freelance chart.

For your own live presentation, visit your Lotus Authorized Reseller. Or call **1-800-TRADEUP, ext. 9420*** for a free, full featured working model. By the way, have you ever used a database?

Lotus
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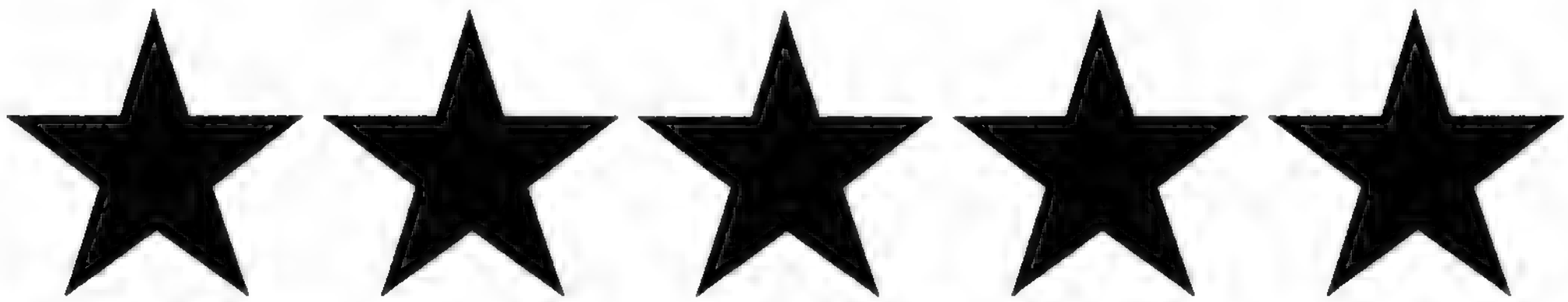
"Freelance is as close to presentation perfection as you'll find on any shelf."
Windows User 8/93

"Creating a presentation of even (100 slides) is absurdly easy--and much easier in many ways than with competing products..."
PC Week 2/15/93



"LOTUS FREELANCE GRAPHICS FOR WINDOWS SCORE: 9.2"

– *Software Digest* 7/93

"MICROSOFT POWERPOINT FOR WINDOWS SCORE: 7.9"

– *Software Digest* 7/93

"(Freelance Graphics) outclasses the competition in features and ease of use."
InfoWorld 6/21/93

"The users in this study were more productive, more effective, and more satisfied with Freelance Graphics than PowerPoint...PowerPoint users took 64% more time to complete their presentations."
Usability Sciences Corp. 3/93

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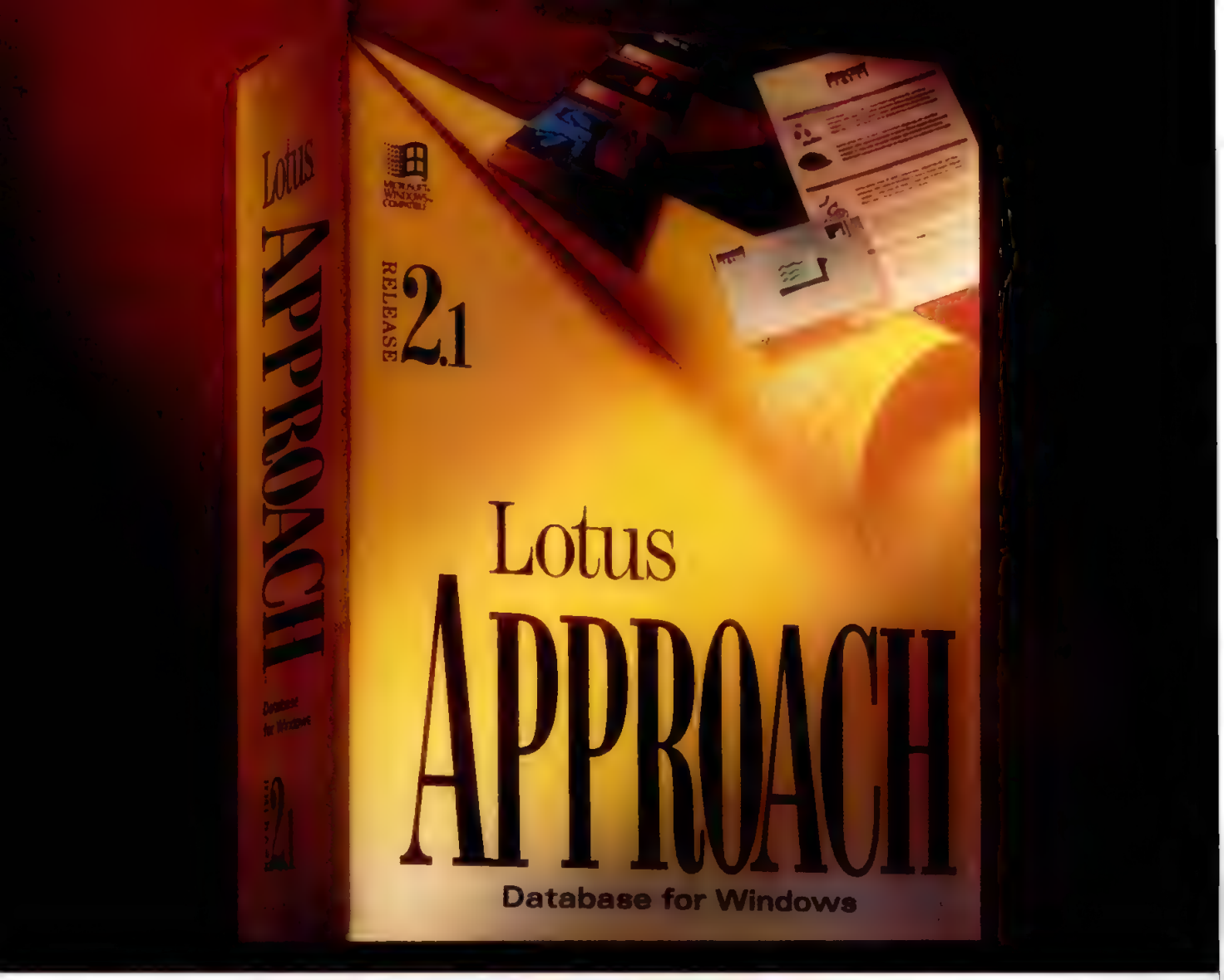
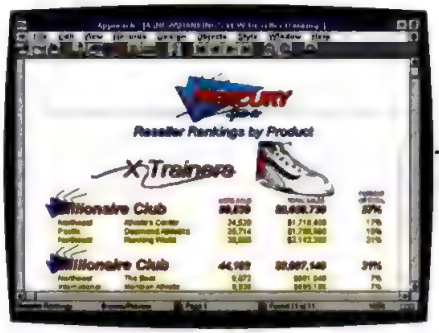


Award-winning Lotus® Approach™ defines a whole new database category: the full powered client/server relational database for the general business PC user. No longer do you have to be a programmer, or think like one, to experience the everyday advantages of a relational database.

Now you, yes you, can build and use your own databases as easily as you build and use your own spreadsheets. For sales reporting, invoicing, project management, customer tracking, mailmerge or hundreds of other uses. Now PC users can enjoy easy, one-click, high-performance access to company data stored in all the major formats (including dBASE,* Paradox,® FoxPro,® Oracle® SQL, SQL Server and DB2®*) across all popular networks.



If you've never worked with a Windows™ database, or if you bought Paradox or Access only to find they were unworkable. Approach will change everything. An independent study found that Approach users are up-to-speed and producing real results in two hours.**

And because Approach is designed to share with other Lotus Windows applications, using Approach databases to mailmerge with Ami Pro,* to share data with 1-2-3* spreadsheets, or to simply report on data is something anyone can do.

What a difference a database makes. Visit your Lotus Authorized Reseller or call **1-800-TRADEUP, ext. 9420.*** Or get the whole suite and save a few hundred bucks.

Lotus
Working Together

*In Canada, call **1-800-GO-LOTUS** **Market Probe International, May 1993 *Requires MicroDecisionware Gateway **Reprinted from Windows Magazine with permission. *1992 by CMP Publications, Inc. 800 Community Drive. Windows is a trademark of Microsoft Corp. Approach is a trademark of Approach Software Corporation, a wholly owned subsidiary of Lotus Development Corporation. dBASE and Paradox are registered

"...Approach offers much easier-to-use database-creation tools for individual users, and easier access to big-time databases than either Microsoft Access or Paradox/Windows...Approach is a big, big winner."
PC Week 6/28/93

"APPROACH... IS BOTH PRODUCTIVE AND HIGHLY USABLE.

"...Approach 2.0 is one of the few (software) packages...for which it's truly possible to never open the manuals."††
Windows Magazine 12/92

ACCESS WILL BE TOO OVERWHELMING FOR END-USERS..."

–*InfoWorld* 1/17/93

"Best Buy Approach is the simplest and most straightforward relational database."
PC World 6/93

"The most usable Windows relational database ever."
PC/Computing 8/93

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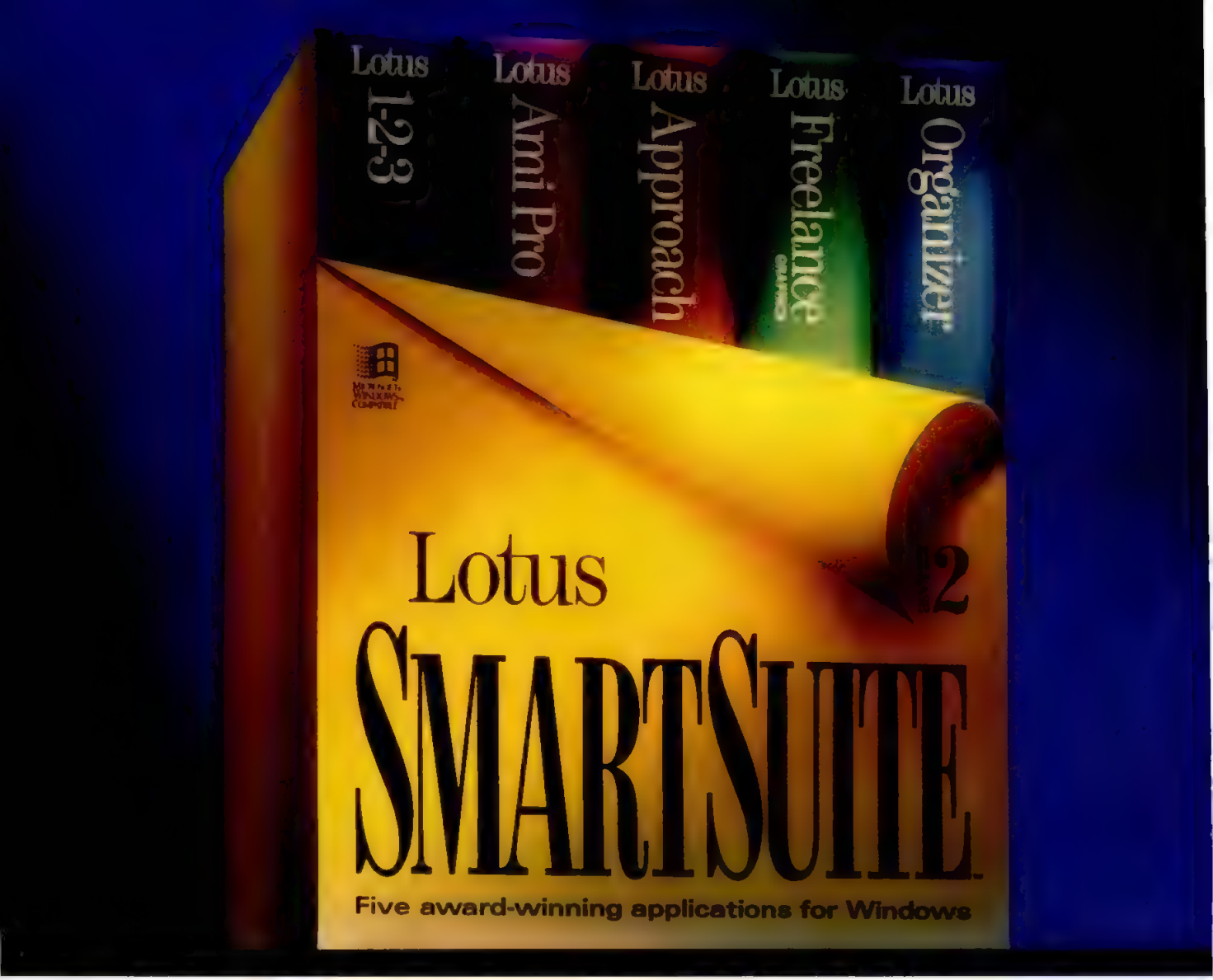


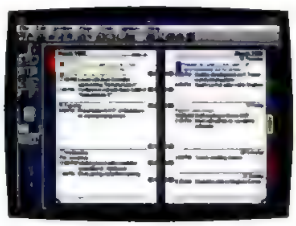
The new Lotus® SmartSuite™ 2.1 is the most complete desktop solution for Windows™ users. It brings together 1-2-3® Release 4, Ami Pro® Release 3.01, Freelance Graphics® Release 2.01, Approach™ 2.1 and Organizer™ 2.1 at an irresistible price (upgrade for just $299***). But it's much more than a deal on an all-star collection of Windows applications.

The applications in SmartSuite 2.1 are closely integrated, sharing a consistent appearance and behavior. This reduces the time it takes for a user to learn each application. For example, the three most used applications in SmartSuite share 26 common SmartIcons® (In Microsoft® Office, they share 3).

Far beyond anything possible with Microsoft Office, Lotus's integration also simplifies the process of switching between applications, sharing information across applications and using functions from one application while working within another.

For example, you can easily edit 1-2-3 charts from within Freelance Graphics. Or use Freelance, or 1-2-3 functions within Ami Pro. All work easily with the Approach database. And all support industry standards, so they'll work with offerings from other vendors as well. This makes working in each application, and the entire Windows platform, easier and more productive than ever before.

SmartSuite is also designed for working in groups in ways Microsoft Office can't. All applications are network ready and mail-enabled with ccMail™. The results of Working Together® are easily manageable through 1-2-3's Version Manager. And each application features additional enhancements for full integration with Lotus Notes.***



Lotus SmartSuite also includes a personal information manager, the award-winning Lotus Organizer.

Unlike Office users, SmartSuite users can call a single toll-free number for support.

For the whole story, visit your Lotus Authorized Reseller. Until 12/31/93, you can upgrade from any Lotus or competitive product to SmartSuite 2.1 for just $299.*** Or for a SmartSuite demo disk, call **1-800-TRADEUP, ext. 9420.***

"LOTUS SMARTSUITE REDEFINES HOW APPLICATIONS SHOULD WORK TOGETHER."

"Lotus now has a top rated product in each of a half a dozen categories... Moreover, Lotus products have come to share a great deal of genuine integration..."
*Soft*Letter* 5/21/93

"When you buy...SmartSuite, the pieces really work together!...The point: There's more to a suite than cramming four boxes into a suitcase and cutting the price."
PC/Computing 8/93

—*PC Letter* 6/7/93

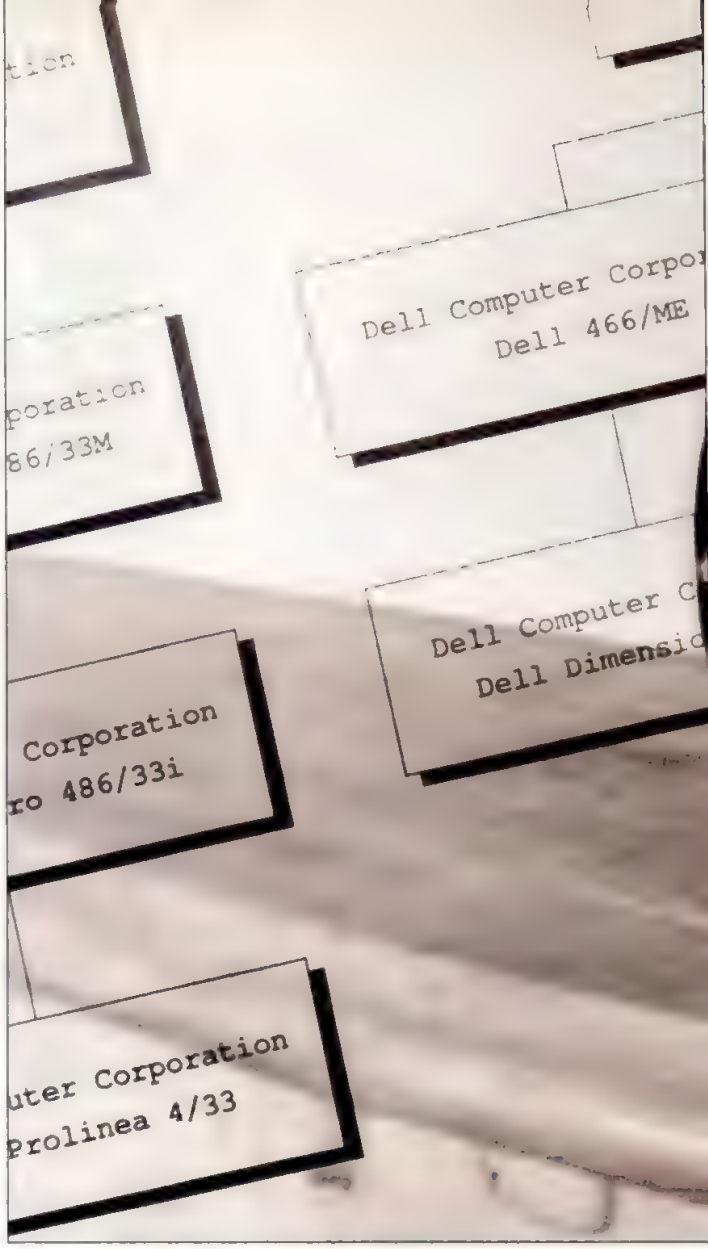
"The level of integration in the SmartSuite makes complicated, cross-application tasks easier for users and lets them take full advantage of...the Windows environment."
Dataquest 6/15/93

*In Canada, call **1-800-GO-LOTUS**. **Consult your Lotus Representative for more information on how to incorporate Lotus Notes and ccMail into your communication strategy. ***$299 direct from Lotus. Offer expires 12/31/93. Qualifying competitive products are Microsoft Excel, Borland Quattro® Pro (not including SE), Microsoft Word, WordPerfect, Wordstar® DisplayWrite,® Microsoft PowerPoint, Harvard Graphics, Corel Draw, WordPerfect Presentation, Aldus® Persuasion. Qualifying Lotus products include 1-2-3 (excluding 1-2-3 for Home), Symphony, Ami Pro, Freelance Graphics, ccMail and Graphwriter® Lotus Notes and Graphwriter are registered trademarks and SmartSuite and Lotus Organizer are trademarks of Lotus Development Corporation. ccMail is a trademark of ccMail, Inc., a wholly owned subsidiary of Lotus Development Corporation. Quattro is a registered trademark of Borland International, Inc. Wordstar is a registered trademark of Wordstar International, Inc. Displaywrite is a registered trademark of International Business Machines Corp. Aldus is a registered trademark of Aldus Corporation.

VALUE LINE PCs

Family Values

With an abundance of PCs, from value-oriented lines to more traditional families, *PC Magazine* gets at the root of the industry's family tree.



by Peter Lewis

Quick quiz: Between a Lexus ES300 and a Toyota Camry, which is the better car for you? Obviously, it depends on what you're looking for in a car. Even though they look vastly different and there's about a $10,000 price difference between them, under the skin the ES300 and Camry are strikingly similar, and they come from the same manufacturer. The Lexus's leather seats, styling, fancy electronics, and quiet ride clearly distinguish it as the luxury line, placing the Toyota in the mainstream. While both cars will get you to the grocery store, the Lexus will do it with a little more performance, panache, and prestige.

In the computer world the distinctions often aren't as clear. For your next PC, you want the zip of a 486 chip, a large hard disk, and a high-quality monitor. You'd also really like the PC to come from a well-known, premium-brand computer company like Compaq, Hewlett-Packard, or IBM. The snag is that you don't want a premium price tag to go with the system's premium performance. As the computer market continues to fragment and redefine itself, the question really becomes, Which of the many families of computers do you want.

Compaq is a case in point. For most, a Systempro is overkill, but do you need a Deskpro? If so, do you want the Deskpro/i or the Deskpro/M? Or will a ProLinea suffice? Now let's make it tough: You've narrowed the field to one of the new "value-line" PCs. How do you choose among the Acer Acros, the AST Bravo, the Compaq ProLinea, the Dell Dimension, the IBM ValuePoint, and the IBM PS/1? Is that a PS/1 Advisor, a PS/1 Consultant, a PS/1 Expert, or one of the other PS/1 models? And, ironically, once you've zeroed in on the model you want, you may be looking in the wrong place because a key facet of today's computer trade is that some models are only available in certain channels. Where you shop is as crucial as the PC you are looking for.

Photograph by Scott Wippermann

Welcome to the newly stratified personal computer industry, where issues of marketing, distribution, and service have become just as important as issues of technology, features, and performance. At the root is the realization by computer companies that they must pursue customers in a way they never have before. Customers have seized control of the industry, and they expect low prices, quality, performance, and steady support. Buyers want the best of both worlds: a system that is rich with features, offers high performance, and is serviced impeccably but comes with a rock-bottom price tag. That makes all systems potential value PCs.

To survive in this new atmosphere, computer companies must go beyond simply making great computers. They must expand product lines with new brands and types of computers, cut prices regularly, shorten product cycles, and aggressively chase after new buyers where they shop. Meanwhile, companies are segmenting their existing product lines into two, three, or even four distinct families—typically by adding new lines at the low end of the spectrum.

Computer firms are also segmenting their so-called distribution channels into a variety of alternatives. The traditional computer dealers and value-added resellers still exist, but they have been supplemented by computer superstores, office supply warehouses, department stores, consumer elec-

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tronics stores, and mass merchandisers—like Wal-Mart and Target. Add to that the ability to order a PC via telephone, through electronic bulletin boards, and mail-order catalogues. The result is that choices abound.

But with choice comes the risk of confusion, overload, and frustration on the part of buyers. *PC Magazine* has undertaken this review of how value-line PCs compare with the industry's more traditional offerings to determine if these machines are truly good values or are stripped-down machines trying to pass as good buys. Just what separates a value-line model from a comparably configured system in the company's premium line?

TRADE-OFFS

There are obvious trade-offs inherent in value-line PCs, compared with high-end systems. But the surprise was that value-line PCs had a lot in common with their high-end brethren. All had the look and feel of what we have come to expect from premium systems, including a high level of fit and finish. In addition, there is no artificial performance ceiling for the value-line systems: All were available with a 486DX2/66 CPU—one tick below Pentium, the current speed demon. Value-line PCs can be ordered with a hard disk ranging in size from 250MB to 340MB, which is fine for the near future for all but the most data-intensive PC users.

On the other hand, in our evaluation of these families, we found several areas where a value-line PC may not measure up to its siblings.

• **Video.** Many value-line systems either had slower video scores than the manufacturer's high-end units or video subsystems that could not adequately resolve the differences between DOS and Microsoft Windows. For screaming Windows performance, look at the ZEOS Upgradable line, which uses the Weitek 9000 video chip plugged into a VESA local-bus implementation (ZEOS offers it as a $149 option). But the same system's performance on DOS applications may drag. The best combination of Windows and DOS video came from ATI's Mach 32 chip set found on the AcerPower 486e, both ALR systems, and the Gateway 2000 4DX-33V.

• **System Memory.** It is unlikely that you will need the capability to expand to 256MB of RAM, but for some it is comforting to be able to make this upgrade. The Compaq ProLinea can go no higher than 32MB; others in this group can use eight times as much RAM.

• **External cache.** Crucial to tapping the full power of the 486DX2/66 processor, the absence of a standard external cache slows CPU performance. Fortunately, there is a wide variety of optional cache sizes and types in this group of PCs. The Acer Acros with a 486DX2/66 CPU came configured without any optional external cache and scored only slightly better than a Hewlett-Packard DX/33 system loaded with a cache.

• **Expansion bus.** While the Micro Channel architecture (MCA) or EISA bus is great for servers, this expensive feature won't help speed a word processing program. All of the value-line systems use the ISA expansion bus, while the higher-end PCs rely on ISA, EISA, or MCA.

• **Cases.** Value-line systems tend to come in slimline or small-footprint cases, which are likely to have two or three free expansion slots. The full desktop case used by most premium-line systems offers five or more slots.

• **Flash BIOS.** Clearly important for incorporating the latest basic input/output software, a flash BIOS was on all the high-end systems except the Northgate ZXP EISA VESA, and in only about half the value-line PCs.

• **Service.** The quality and quantity of service varied greatly in this test group. For

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HIGHLIGHTS

Value-Line PCs

FAMILY LINES of the personal computers we looked at were apparent. Value-oriented products typically have the look and feel of premium computers, but these products cut corners by offering fewer expansion options or by using slower video systems.

HIGH-QUALITY PCs from mail-order houses started the industry's trend toward segmentation. The major PC manufacturers saw an opportunity to broaden their appeal by introducing entry-level systems that would compete with machines from Gateway 2000 and ZEOS.

CHOICES, CHOICES The major outcome of segmenting the market is buyer confusion. Should you purchase a stripped-down premium computer or load up a value-line system? It depends on your expectations and your computing style.

SEGMENTATION BASED on software is one way of splitting the lines. For example, the five nearly identical members of IBM's PS/1 family differ only in bundled software and where they are sold.

COMPROMISES ABOUND with value-line PCs. Be most aware of this when looking at external RAM caches—especially with a 486DX2/66-based system—video, RAM upgrades, and case styles.

NEW COMPAQ AND IBM LINES show where the value market is heading. Compaq's Presario will be housed in one box and will be oriented for ease of use. IBM also has a new brand with similar goals, called Ambra. It will be made in Asia and will be aimed at entry-level buyers.

EVEN APPLE COMPUTER is getting in on the act with its Performa value line.

instance, the Northgate 486VL and Northgate ZXP EISA VESA come with a year of free on-site service, while the buyer of the low-end Superb must shell out $78 for this service. There generally isn't any difference between value-line and high-end guarantees, but the IBM PS/1 486DX2/66 comes with a one-year replacement policy via overnight shipping if the PC breaks, while the IBM ValuePoint offers on-site service. Most PC makers offer one-year warranties (Acer, Dell, Gateway, Northgate, and ZEOS), others three years (Compaq, HP, IBM, and NCR), and one five years (ALR).

• **Power supply.** With the exception of the HP, all the high-end systems came with a power supply on the order of 200 watts; the value-line PCs had power supplies that ranged from 75 to 200 watts. But unless you plan to fill the case with storage media or expansion cards, a 75-watt power supply should suffice.

• **Software.** Increasingly the software that comes free with a system is a defining element. IBM's multiple PS/1 PCs are essentially the same systems that are differentiated by where they are sold and by what software is included. All come with DOS and Windows (DX2/66 systems come with OS/2 2.1 and offer DOS and Windows as an option), as well as starter kits for Prodigy and America Online. The buyer also chooses from Quicken, WinFax Lite, and one additional program, based on where it is purchased: PS/1 Essential adds Calendar Creator Plus, PS/1 Expert adds Address Book Plus, PS/1 Consultant offers The New Print Shop, PS/1 Advisor adds Grammatik, and PS/1 Investor adds Amaze Daily Planner.

The unspoken risk is that a value-line PC will come up short, or that it uses yesterday's technology and is somehow not state of the art. The bottom line is that a value-line PC may use a good but not great hard disk controller, or a video chip set that is good at either DOS or Windows but not both. It may also lack a feature that the user may wish for later on, like local-bus video.

PC MAGAZINE ▶ EDITORS' CHOICE

• Value, but Compromises

In the world of value-line personal computers, compromise is unfortunately the watchword. Before buying any entry-level PC—value-line or otherwise—look at the performance and features you must sacrifice for the system's price. While the value-line systems we looked at can be expected to satisfy the average user's computing needs today, all have at least one "gotcha"—a missing or deficient element—that makes them pale in comparison with high-end systems. For this reason, none of the value-line systems—the focus of this review—earned an Editors' Choice rating.

• The Acer Acros is a fine system that would have been better had Acer configured it with at least 128K of external cache—an option on the Acros family.

• The ISA-based ALR Evolution IV 4/33 has a design that includes many attributes of a midrange PC. The problem was that these advantages were not translated into performance, with the system lagging in terms of its processor and Windows video scores.

• The Compaq ProLinea 4/33 was in the enviable position of making several high-end systems seem slow. However, its Graphics Winmark score of below 10 million megapixels per second is not acceptable in a graphics-oriented computing world.

• The Dell Dimension 486/66 combines a case and system design that offers room to grow, but with spotty benchmark test results. While out in front in processor and memory performance, its disk score disappointed.

• The low-end Gateway 2000 4DX-33 serves mostly to show us how much we like the company's midrange V family.

• The HP Vectra 486/33VL is the newest machine in our roundup, and on paper it looks like a winner: VL-Bus graphics, a 128K write-back cache, and a three-year warranty. While none of its benchmark test scores were bad, none stood out from the crowd, either.

• The second-generation IBM ValuePoint and PS/1 show a renewed interest in mainstream systems. The ValuePoint line is neither blindingly fast nor sluggish, and it is expensive.

• The NCR System 3333, the most expensive entry-level system in this roundup, gives a lot for the money. But at close to $3,000, its price doesn't reflect the latest industry-wide cuts.

• The Northgate Superb packs a lot of value into its $2,499 price for a DX2/66 PC, but falls short in DOS video. The buyer must pay an additional $78 for a year of on-site service.

REVIEW CRITERIA

So we could thoroughly evaluate the various families of PCs, we asked vendors to provide similarly configured representatives of each line they make, as long as the lines had separate identities. While there are no hard and fast definitions of this concept, we looked only at lines that were marketed independently and were based on distinct motherboards. The minimum configuration we asked for included a 486SX/25 processor or better, 8MB of RAM, a 14-inch monitor, a 170MB hard disk, and DOS and Windows. As standards for comparison, we also invited two direct-response PC companies (Gateway and ZEOS) to send us similar systems. This field has grown tremendously from the original mail-order concept to include 800-line numbers, catalogues, and even on-line ordering schemes. It has been the success of the direct-response companies that spawned this move among the industry's largest manufacturers toward value-line PCs so they could compete directly in this growing area. The crossover company is Northgate, which made a name for itself

supplying inexpensive PCs through the direct channel and now offers several lines, three of which we review here.

FAMILY HERITAGE

We are more concerned here with what each system could tell us about the family it belongs to than its individual performance. The focus is on value-oriented PCs, with their high-end PC cousins present to provide perspective. We received 9 value-line systems and 13 premium brands from Acer (the Acros and AcerPower 486e), ALR (the Evolution IV 4/33 and Evolution IV 4E/33), Compaq (the ProLinea 4/33, Deskpro 4/33i, and Deskpro 486/33M), Dell (the Dimension 486/66, Dell 466/M, and Dell 466/ME), Hewlett-Packard (the Vectra 486/33VL and Vectra 486/33XM), IBM (the PS/1 486DX2/66 and ValuePoint), NCR (the System 3333 and System 3350), and Northgate (the Superb, 486VL, and ZXP EISA VESA); the direct-response camp is represented by the Gateway 2000 4DX-33 and 4DX-33V PCs and the ZEOS 486DX2-66 Upgradable. Indicative of the power that users want, all the systems use either a 486DX or 486DX2 CPU.

As expected, in an industry where technology moves at warp speed, many a company was in the midst of revamping one or more of its lines. We took this opportunity to look ahead at what is in store for value-line systems from AST and NEC in mini-reviews that appear alongside the others. We take a general view of the direction the industry is heading in (see the sidebar "Missing in Action").

In any event, the segmentation of the computer business may be a sign that it is maturing. When the automobile industry was young, Henry Ford offered any car the buyer wanted—as long as it was a black Model T. Not long ago, all telephones were black, clunky, and from AT&T. Today there are sports cars, trucks, minivans, and family sedans, and you can buy a telephone that looks like a duck or one that fits in your pocket.

By the same token, when the computer industry was young, most buyers ordered an IBM PC. The options typically were 64K or 256K of RAM, one floppy disk drive or two. The power users added a Hercules card and a modem. As new technologies emerged, they still fit in the same box. Today there are servers, workstations, and desktop PCs, with options galore. In the future, computers will certainly take additional forms as new groups of customers are identified.

The goal in this evolving field of value-line computers is to match customers' varying needs and budgets with appropriate levels of features and performance—without the systems becoming so similar as to be commodities. The competitors fighting for a piece of the value category are not just the no-name clones from Korea and Taiwan, but also such billion-dollar players as AST, Compaq, Dell, Gateway, HP, and NCR. While the computer companies have now set their sights more closely on the home- and small-office buyer, it is not at the expense of the corporate buyer looking for a bargain. Appealing to that market means doing things in a new way, in new places. Ironically, Compaq and IBM, once the two most stolid proponents of the "old way," are setting the course for the new way.

Major IBM marketing mistakes in the 1980s show just how powerful a force the segmented market can be. With a product line spanning mainframes to PCs, IBM maintained segmentation and avoided cannibalism within the lines by crippling models, including the original PC, as well as the PCjr and the early PS/1. The strategy worked in the old world, where a company might buy all of its computers from IBM, but in the real world, crippled systems are seen as inferior systems.

The lack of reasonably powerful, inexpensive systems from the large PC companies caused the present restructuring. The first salvo of what turned into a full-scale price war was Compaq's stunning price cuts last June. By reducing profit margins of the past, Compaq forced the industry to fall in line. Suddenly the clones no longer had as much of a price advantage over first-tier products. This marked the end of the first era of the personal computer industry and set the stage for the second, one in which value-line computers could thrive.

Compaq's premium Deskpro line did

Suitability to Task: Value-Line PCs

The **DOS applications** score reflects a system's ability to run DOS software quickly. To earn an *excellent* rating, a PC needs at least a 200MB hard disk and a DOSmark score in the top 25 percent of the roundup.

Windows applications is a more demanding category; the rating indicates how well a system will operate Windows software. Factors include the Graphics and Disk Winmark scores, the DOSmark score, the maximum motherboard RAM, hard disk options, the maximum noninterlaced video resolution, the monitor size, and the presence of a mouse port. Well-designed systems containing top-flight video controllers and fast hard disks received *excellent* ratings.

Expandability refers to a system's potential for growth. Considerations include ease of processor and external cache upgrades, system BIOS, hard disk options, maximum RAM installable on the motherboard, available drive bays and bus slots, and the presence of 16550 UART support. The best systems have drive bays and slots to spare, and easily upgradable processor/cache subsystems.

▶ Product Name	
SUITABILITY TO TASK	
DOS applications	POOR
Windows applications	FAIR
Expandability	GOOD
VENDOR SERVICE & RELIABILITY	
Reliability	AVERAGE
Repair service	ABOVE AVERAGE
Technical support	BELOW AVERAGE

SERVICE AND RELIABILITY

In our 1993 Service and Reliability Survey, we sent questionnaires to 17,000 subscribers selected at random; about half of them shared their experiences with us. We publish results only for those vendors for which we received an adequate number of responses. For more information, please see our July 1993 issue. Vendors are rated *above average, average,* or *below average* in three areas:

Reliability scores indicate to what degree PC owners felt their systems met their overall expectations for consistent operation.

Repair service scores are culled from those users who contacted the manufacturer to have their PCs repaired. The scores reflect users' satisfaction with the service they received.

Technical support scores are a measure of how well the vendors' telephone support services met the respondents' expectations.

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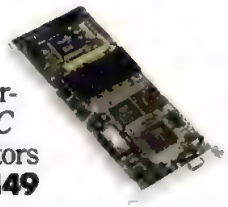

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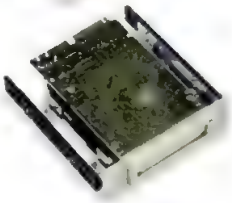

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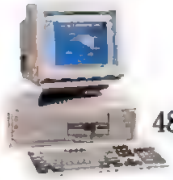

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Price/Performance Index: Value-line PCs

The overall performance winner of this roundup of value-line PCs versus more traditional high-end systems was the ZEOS 486DX2-66 Upgradable, primarily a result of its superior Graphics Winmark scores.

The high-performance/low-price segment of the price/performance chart is noticeably empty for this group of 22 systems. While you can easily configure a system either to be the utmost in processing ability or to fit into a tight budget, we found that none of the value-line PCs we tested adequately resolved these two competing interests.

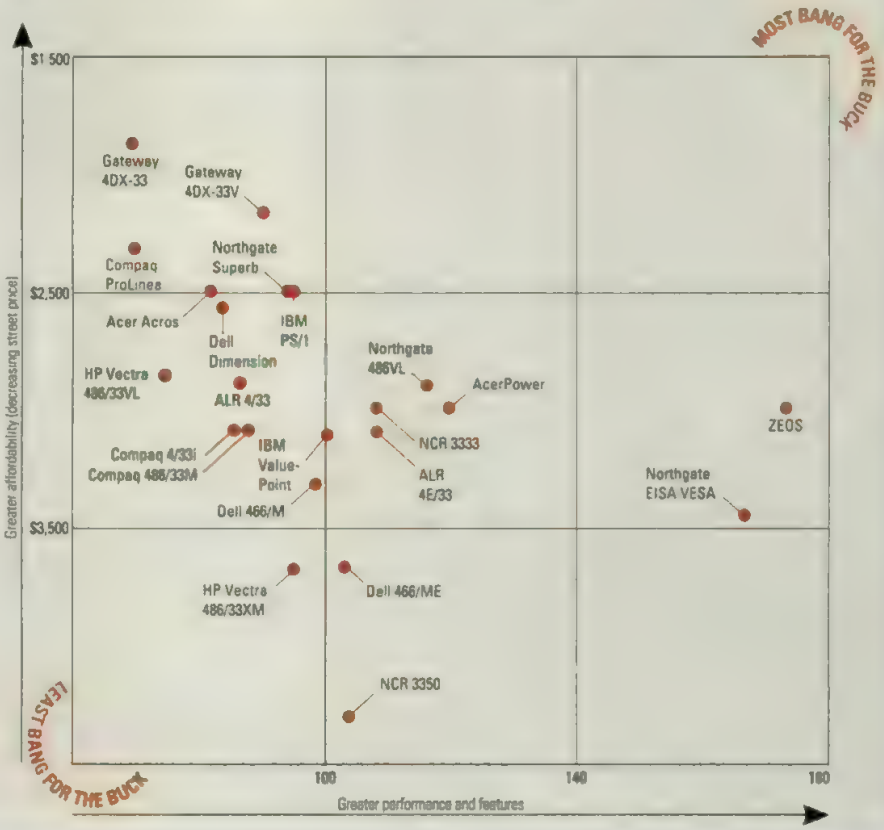
At the center of the price-performance chart were the high-end ALR Evolution IV 4E/33 and AcerPower 486e alongside the value-line NCR System 3333 and Northgate 486VL. These four systems should provide good performance and features for about $3,000.

Above this center spot on the chart were four PCs that offered average overall performance and features but at a higher price. The Dell 466/M and its close cousin the 466/ME, the HP Vectra 486/33XM, and the NCR System 3350 are priced below $4,300

The Gateway 2000 4DX-33 value-line system was the low-price leader of this roundup. Unfortunately, it was also the underachiever of the group

THE DATA POINTS

The Price/Performance Index attempts to resolve the competing interests of high performance and features and low price. The chart reflects each machine's benchmark test scores, hard disk capacity, installed RAM, video RAM, processor socket, flash BIOS, and expansion features such as number and size of available drive bays and expansion slots The index also reflects important extras such as local-bus video, 16550 UART support, extended warranty, on-site service, and bundled software. Benchmark test scores are weighted to account for half of the performance portion of the index, capacity and expansion features account for 45 percent, and the extras account for 5 percent of the total. Prices are based on our tested configuration. For more information see PC MagNet's Software Library Editorial Forum as 16BANG WK1



boast impressive features that delighted power users, including high-performance graphics (QVision) and integrated sound capabilities (Business Audio). But cutting-edge features made for expensive machines. The low-cost end of the Deskpro line may have made corporate customers very happy indeed, but it still did not reach the new customers who Compaq needed to sustain its growth.

Following the lead of AST's Bravo line (introduced in 1988), Compaq brought out the ProLinea family, reasoning that there was demand for affordable, workhorse desktop computers—ones that weren't necessarily state of the art but were solid, reliable systems. Taking the lead of the best direct PC vendors, Compaq radically cut product development time and manufacturing costs without cutting corners, and has generally been successful in capitalizing on its reputation as a maker of high-quality, reliable computers. Key to being lean is farming out the development of components, such as hard disks. The result is that today nobody designs and builds all PC parts.

AMBRA VS. PRESARIO

IBM recently redefined the borders among its lines. IBM's family tree looks something like this today: At the high end is the PS/2, with the PS/1 and the ValuePoint on parallel and often overlapping branches. For instance, a comparably configured ValuePoint costs about $500 more than a PS/1, but you get local-bus graphics.

IBM will further reshuffle its PC deck with a fourth line. Called Ambra and already marketed in Europe and Canada, this line uses separate system unit boxes and monitors, is based on an outside design. What is new is that Ambra will be extremely aggressive in pricing: A 66-MHz system with a 340MB hard disk, built-in SCSI support, and a 15-inch monitor will cost around $2,000.

In contrast, Compaq recently unveiled its own fourth PC family, called Presario, an entry-level machine housed in a one-piece box similar to the Macintosh Classic. While this simplifies shipping and

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store displays, it limits future expansion by having only two expansion slots and lacking space for an internal CD-ROM drive. The Presario is expected to appeal to home-office and low-end corporate buyers, for whom ease of set-up and use are paramount.

A fancy brand name doesn't necessarily guarantee the best price-performance ratio or the best overall value. Some of the better-known brands were lackluster performers on our tests, illustrating that not all 486s are created equal. While Dell's Dimension line provided exceptional processor performance, it lagged in hard disk speed. The IBM ValuePoint line did well in hard disk performance but fell short in processor performance. Some systems, like the ZEOS we included as a comparison system, led in some categories and trailed in others.

Is a value-line PC in your future? That depends on your computing needs. Each value-line PC we reviewed had a missing or deficient element that detracted from an otherwise fine design. By contrast, top-line PCs offer superior performance across the spectrum of uses.

Like flying coach, any of a number of value-line PCs will get you to your destination. Just as there will always be a following for first-class travel, there'll always be a computing elite, whose needs will dictate the extra power of a premium system. It's good to know the choice will always be there.

Acer America Corp.

Acer Acros
AcerPower 486e

Acer America Corp. sells four lines of computers in the U.S. that are targeted at small- to medium-size businesses: three DOS/Windows lines arranged in a three-tiered structure, and the Acer Altos line, which is aimed at the Unix workstation market.

Acer

VENDOR SERVICE & RELIABILITY	
Reliability	AVERAGE
Repair service	AVERAGE
Technical support	BELOW AVERAGE

The DOS-based lines are the entry-level Acer Acros (a desktop PC), the high-end AcerPower 486e (also a desktop PC), and the AcerFrame tower line of EISA-bus file servers (not in this roundup). The low-cost line is sold largely by mass merchandisers and distributors but is also available to VARs and system integrators, the main selling channels for the AcerPower and AcerFrame lines. All Acer systems have a one-year warranty with free on-site service and toll-free technical support. The Altos and AcerFrame lines have slightly more advanced support.

Acros

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	FAIR
Expandability	FAIR

AcerPower 486e

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	GOOD
Expandability	GOOD

The Acros line is based on an ISA-bus motherboard with four 16-bit ISA slots, two of which have VESA local-bus extensions. Available with CPUs ranging from a 486SX/25 to a 486DX2/66, the Acros comes in a baby-AT case with four drive bays (three are accessible). The system includes a VESA integrated local-bus graphics accelerator with 1MB of VRAM and integrated I/O and disk controllers. This leaves all four expansion slots free.

System memory on the Acros can be expanded to 68MB, with 4MB wired into the motherboard and 64MB more installable in four SIMM sockets. No external RAM cache is standard, but a 256K cache option is available for $100; a RAM cache is recommended for the more powerful chips of the 486 family. The tested Acros had a DX2/66 CPU, 8MB of RAM, a 15-inch monitor, and a 244MB hard disk was priced competitively a for a value-line system: $2,499.

The Acros is best suited for home use, home office or small business use, or network node applications where the fastest performance and expansion capacity aren't as important as a low price and a small footprint. If you need hotter performance or more expansion, the AcerPower might be a better bet.

The EISA-based AcerPower provides performance and expansion beyond the Acros line. It has six drive bays (four are accessible) and seven expansion slots. The two internal drive bays are located directly over the power supply, a possible threat to drive longevity. Expansion slots on our test machine include two 16-bit ISA slots and four 32-bit EISA slots.

The AcerPower has a standard 128K secondary RAM cache, expandable to 256K, and a 256MB system RAM capacity. While the test system uses an EISA combination IDE drive controller and I/O card, a SCSI-II hard disk controller is integrated onto the motherboard. The test system also came with an ATI Mach 32–based accelerated local-bus video controller. The video board's effect during our tests was the best news for the AcerPower's otherwise average perfor-

FACT FILE

Acer Acros

List price (tested configuration): $2,499

Memory/processor RAM cache: 8MB 70-ns SIMMs.

Disk drives and controller: Conner BM95K72 14-ms 244MB IDE hard disk with 64K cache, integrated disk controller, 1.2MB and 1.44MB floppy disk drives.

Display: Integrated video controller with 1MB DRAM, AcerView 56L 15-inch monitor with a 72-Hz refresh rate at 1,024-by-768

Software: DOS 6.0, Microsoft Windows 3.1, America Online, MS Entertainment Pack, MS Productivity Pack, MS Works 2.0, Phoenix MicroFAX, Quicken.

AcerPower 486e

List price (tested configuration): $2,995.

Memory and processor RAM cache: 8MB 70-ns SIMMs, 128K external cache

Disk drives and controller: Conner BM958WT 14-ms 244MB IDE hard disk with 64K cache, Acer Super I/O Card E4+ ISA card disk controller, 1.2MB and 1.44MB floppy disk drives.

Display: Acer Local Bus proprietary video controller with 1MB VRAM, AcerView 56L 15-inch monitor with a 72-Hz refresh rate at 1,024-by-768

Software: DOS 6.0, Microsoft Windows 3.1.

In short: Acer offers a clear differentiation between a low-end ISA local-bus system, a midrange EISA machine, and a high-end tower line (not tested)

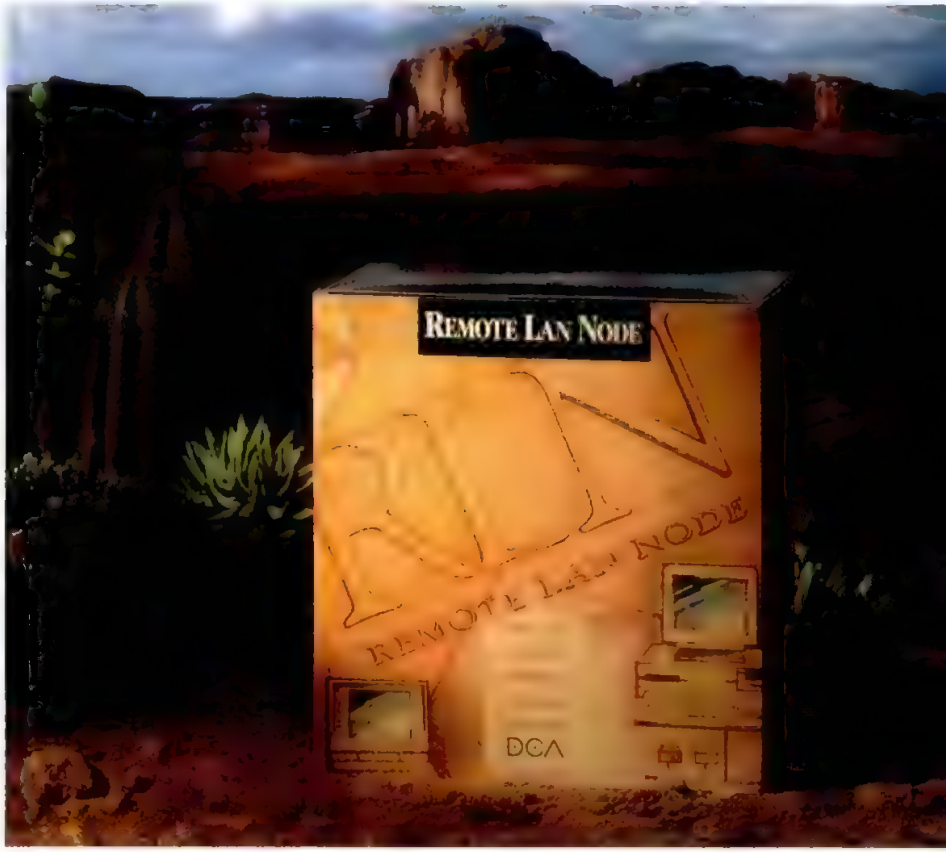
Acer America Corp., 2641 Orchard Pkwy., San Jose, CA 95134; 800-733-2237; 408-432-6200; fax, 408-432-6221.

471 ON READER SERVICE CARD

WHEN REMOTE ACCESS PRODUCTS WERE TESTED IN THE ARIZONA DESERT, GUESS WHO HAD THE HOTTEST SOLUTION?

The test was part of a comprehensive analysis of remote network access solutions done by ZD Labs. They packed up nine dial-in server products and sent a technician out to do some real field testing—in the town of Sedona, Arizona, pop. 7940.

He dialed in to the ZD Labs LAN in Foster City, California. And when he logged off, he had a winner: Remote LAN Node® (RLN™) from DCA®—a unique software solution that lets up to 16 remote users dial in at once and function just like locally connected PCs.



RLN PROVED IT COULD TAKE THE HEAT.

We'll let ZD Labs do the talking. "The best product was Remote LAN Node—a software solution that acts like a multiprotocol router when installed on a PC on a LAN."

The report went on to say, "Our winner, DCA's RLN, stood out for its capability to handle multiple communications protocols," commenting that "it won hands-down on flexibility, allowing our remote users to connect to both IPX and IP servers in the same call."

All in all, the report concluded, if you're looking for versatility, "None of the other units we tested came close."

THE BEST SOLUTION UNDER THE SUN.

Remote LAN Node extends the full capability of the network to remote users, allowing them to function as true remote nodes.

RLN is both protocol- and application-transparent. So you can access any network protocol, such as IPX/SPX (Novell®), SPP/IPC (Banyan®), NetBEUI (Microsoft®) and TCP/IP—or any interconnected combination. And, as ZD Labs pointed out, you can access them simultaneously. You only dedicate one PC as a comm server for 16 concurrent users. And RLN offers three levels of configurable security, including the industry's first Remote Security Adapter.

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Call us, and we'll send you a reprint of a *Corporate Computing* article detailing the ZD Labs test report. We'll also send an informative booklet, "Just Like Being There—A Guide To Remote Network Access."

And finally, we'll send you a free copy of RLN client software, so you can dial in to our LAN Lab server and judge for yourself.

You won't have to go to the desert. In fact, you won't have to leave your office. But you'll find yourself in a whole new world.

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CIRCLE 901 ON READER SERVICE CARD

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All our PCs are backed by the COMPAQ free 3-year warranty†—the first such warranty in the industry. We can offer this kind of long-term guarantee because of our quality and testing standards. Prices include COMPAQ Monitors. Call for details on other COMPAQ desktops and notebooks, as well as printers.

COMPAQ ProLinea 3/25s
25-MHz 386SX, 2-MB RAM, 120-MB hard drive, VGA Color Monitor. An affordable entry-level desktop PC.

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COMPAQ ProLinea 4/25s
25-MHz 486SX, 4-MB RAM, 120-MB hard drive, SVGA Color Monitor. Great for everyday business applications.

COMPAQ ProLinea 4/33
33-MHz 486DX, 4-MB RAM, 120-MB hard drive, SVGA Color Monitor. Designed for more advanced applications.

COMPAQ ProLinea 4/66
66-MHz 486DX2, 4-MB RAM, 120-MB hard drive, SVGA Color Monitor. For high performance at an affordable price.

ProLinea Features

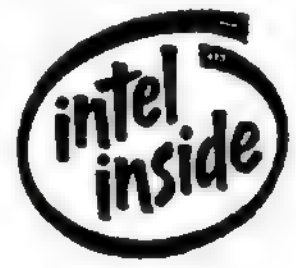
3½" 1.44-MB diskette drive ◆ 1024 x 768 local bus video graphics with 1-MB VRAM in up to 256 colors (on 486 models) ◆ 3 expansion slots ◆ 3 internal storage device positions ◆ Security features ◆ COMPAQ Color Monitor, preinstalled MS-DOS 6.0 and Microsoft Windows 3.1 and a COMPAQ Mouse.

DESKPRO/i Features

*3½" 1.44-MB diskette drive ◆ Integrated QVision Graphics displays up to 256 colors at 1024 x 768 with 512-KB VRAM option** ◆ 3 expansion slots ◆ 3 internal storage device positions ◆ Security features ◆ Business Audio ◆ COMPAQ Color Monitor, preinstalled MS-DOS 6.0, Microsoft Windows 3.1 & Sound System Software, COMPAQ Mouse & Microphone.*

COMPAQ DESKPRO 4/25is
25-MHz 486SX, 4-MB RAM, 120-MB hard drive, SVGA Color Monitor. Delivers fast, high-resolution graphics in Windows.

COMPAQ DESKPRO 4/33i
33-MHz 486DX, 4-MB RAM, 120-MB hard drive, SVGA Color Monitor. For even faster performance in a Windows environment.



Contura Features

3½" 1.44-MB diskette drive ◆ Power conservation and security features ◆ Battery Pack ◆ AC Adapter ◆ Preinstalled MS-DOS 6.0, Microsoft Windows 3.1 and EZ Help On-Line Library and a COMPAQ Trackball.

COMPAQ Contura 3/25
25-MHz 386SL, 4-MB RAM, 120-MB hard drive, monochrome VGA display, 6.2 lbs. An affordable notebook loaded with features.

COMPAQ Contura 4/25
25-MHz 486SL, 4-MB RAM, 120-MB hard drive, monochrome VGA display, 6.2 lbs. Upgradeable to Active Matrix Color Display.

COMPAQ DirectPlus

1-800-888-0174

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TIME IS AND CALLING CO CAN SAVE

We've put together these bundles to make it easy to get the hardware and software that you need in a complete system, at one special price. No matter what your computing needs, chances are that one of these bundles will fit the bill. Not only that, but the price you'll pay will fit well within your budget.

The Basics Plus.

COMPAQ ProLinea 4/25s
25-MHz 486SX, 4-MB RAM, 120-MB hard drive, SVGA Color Monitor.

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WinFax PRO for Windows

Microsoft Works for Windows

Calendar Creator Plus Windows

AfterDark for Windows

Quicken for Windows

This entry-level system gives you a full range of business and personal applications as well as data and fax communications—all at a surprisingly low price.

$1,599
*Or $57 per month**
Save over $228†

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MONEY.
MPAQ DIRECTPLUS
YOU BOTH.

The Front Office.

COMPAQ ProLinea 4/33
33-MHz 486DX, 4-MB RAM,
120-MB hard drive,
SVGA Color Monitor.

Quattro Pro for Windows

WordPerfect for Windows

This general business solution, which is offered to you at a very competitive price, teams up two popular word processing and spreadsheet applications.

$1,899
*Or $68 per month**
Save over $274†

The Windows Office.

COMPAQ DESKPRO 4/33i
33-MHz 486DX, 4-MB RAM,
240-MB hard drive,
1024 Color Monitor.

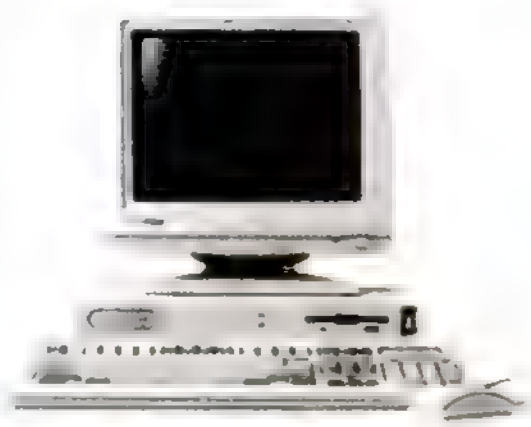
Extra 2-MB of RAM

The Microsoft Office for Windows

This solution can utilize COMPAQ business audio with the most popular Microsoft applications. The Microsoft Office includes Microsoft Excel, Word, PowerPoint and Mail.

$2,699
*Or $97 per month**
Save over $239†

The Office Pro.



COMPAQ ProLinea 4/50
50-MHz 486DX2, 4-MB RAM,
240-MB hard drive,
SVGA Color Monitor.

Extra 4-MB of RAM

14.4-Kbps Data+Fax Modem

WinFax PRO for Windows

Lotus SmartSuite for Windows

This solution offers data and fax communications with popular Lotus applications. Lotus SmartSuite includes Lotus 1-2-3, AmiPro, Freelance Graphics, Organizer and cc:Mail.

$2,899
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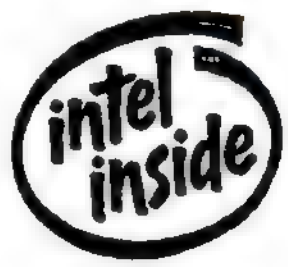
Save over $279†



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CIRCLE 137 ON READER SERVICE CARD

Acer Acros and AcerPower 486e

mance for the DX2/66 systems. Sold mostly by VARs and system integrators, although also available via mass merchants and distributors, the $2,995 AcerPower, with moderate expansion ability and midrange performance, is adequate but not overwhelming.

Acer's clear differentiation across lines—a local-bus ISA machine with limited expansion, an EISA-bus system with a local bus and more expansion room, and a tower-based server line—helps customers and resellers decide what best meets their specific performance and expansion needs. Acer's pricing is competitive but not overly aggressive, which matches its systems' midrange performance levels.—*Bruce Brown*

Advanced Logic Research Inc.

ALR Evolution IV 4/33
ALR Evolution IV 4E/33

Advanced Logic Research sells a wide variety of computer models, represented by seven different lines. The ALR menu of systems at first may seem confusing, because the company's offering is a mix of old and new with significant overlap among them. A broader look reveals systems for a wider-than-normal application spectrum, meeting continued demand for older models while presenting new technology advances often earlier than other vendors do.

ALR

VENDOR SERVICE & RELIABILITY	
Reliability	AVERAGE
Repair service	AVERAGE
Technical support	BELOW AVERAGE

The main contemporary ALR lines, in order of increasing sophistication and cost, are the new Flyer VL Green PC entry-level systems; the midrange to high-end Evolution IV systems, available with either an ISA or EISA bus; and the high-end ProVEISA, VQ, and Evolution V file servers. Two other computer lines—the MPS MicroChannel Architecture and the BusinessVEISA series—are no longer advertised but are still sold by ALR to value-added resellers or system integrators that typically supply them to clients that have a large installed base of these systems.

All sales channels—including ALR's direct sales force, ALR dealers, VARs, and system integrators—have access to all ALR lines. All lines have the same standard service-and-support mix with a warranty covering parts for 5 years and labor for 15 months; low-cost, on-site service ($9.95 for the first year); and toll-free technical support during weekday business hours and half the day on Saturdays. They also have a variety of extended service options, and the VQ and ProVEISA lines have special extended service options.

ALR's entry-level Flyer line has recently been revamped and could not be included here. The Flyer VL Green PC includes a 32-bit VESA VL local-bus system based on the Western Digital RocketCHIP video graphics accelerator. The slimline case has only three drive bays, which precludes its use for multimedia applications. A typical low-end configuration with a 486SX/25 CPU, 4MB of RAM, and a 170MB hard disk would list for approximately $1,500 without a monitor. The "Green" in the Flyer VL Green PC line refers to its CPU sleep mode, which slows down the processor speed based on use; the system complies with the EPA Energy Star program.

While the Flyer VL Green PC's local bus has the potential to offer good performance, the tested Evolution IV computers have more drive and card expansion room in their small-footprint cases. Usually purchased as single-user machines, Evolution IVs are at times used as file servers for small networks. The Evolution 4/33 is an ISA system, while the 4E/33 is based on the EISA bus. Both have three accessible and one internal drive bay and six expansion slots. Each version of the Evolution IV has two VESA local-bus slots; as expected, the ISA version has

Evolution IV 4/33

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	FAIR
Expandability	FAIR

Evolution IV 4E/33

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	FAIR
Expandability	GOOD

FACT FILE

ALR Evolution IV 4/33

List price (tested configuration): $2,889
Memory and processor RAM cache: 8MB 80-ns SIMMs
Disk drives and controller: Western Digital Caviar 2250 14-ms 255MB IDE hard disk with 64K cache, integrated disk controller, 1.44MB floppy disk drive.
Display: ATI VLB Mach 32 VESA video controller with 2MB VRAM, ALR FlexVIEW 3X-NI 14-inch monitor with a 60-Hz refresh rate at 1,024-by-768
Software: DOS 6.0, Microsoft Windows 3.1.

ALR Evolution IV 4E/33

List price (tested configuration): $3,096
Memory and processor RAM cache: 8MB 80-ns SIMMs
Disk drives and controller: Western Digital Caviar 2250 14-ms 255MB IDE hard disk with 64K cache, integrated disk controller, 1.44MB floppy disk drive.
Display: ATI VLB Mach 32 VESA video controller with 2MB VRAM, ALR FlexVIEW 3X-NI 14-inch monitor with a 60-Hz refresh rate at 1,024-by-768.
Software: DOS 6.0, Microsoft Windows 3.1.
In short: ALR's many computer lines overlap, making it difficult to find the ones that are truly for you.

Advanced Logic Research Inc., 9401 Jeronimo, Irvine, CA 92718; 800-444-4257; 714-581-6770; fax, 714-581-9240.

472 ON READER SERVICE CARD

three additional 16-bit ISA slots, and the EISA version has three EISA slots. Both machines also have a 32-bit proprietary slot for either a secondary processor or a Tri-Combo card that includes an I/O adapter, Ethernet controller, ATI 1MB or 2MB VRAM, and a 256K cache.

Neither Evolution IV system comes standard with an external RAM cache, but a 256K option is available for $149. Both came configured with an ATI local-bus Mach 32 Windows graphics accelerator board, an ALR FlexView 3X-NI 14-inch 1,024-by-768 monitor, and a Western Digital Caviar 255MB hard disk. The $2,889 ISA-bus system has a 52MB maximum RAM capacity, while the $3,096 EISA model supports up to 256MB of installed system RAM.

On our tests, the Evolution IV models were consistent performers, with the 4E/33 EISA version generally scoring just ahead of the 4/33 ISA-bus system. The ALR systems were not outstandingly fast or slow compared with other vendors' computers with the same CPU, although they did tend to place in the lower ranks.

The complexity of ALR's high-end server lines calls for the typical planning and careful application specification and configuration required with that level of system. The Evolution IV systems are easier to configure and buy based on application need, and would be appropriate for most mid- to high-level applications.—*BB*

PC FAMILY PROFILE

AST Research Inc.

AST Bravo
AST Advantage!
AST Premmia

AST Research, which recently acquired the GRiD line of desktop, notebook, and

Missing in Action

by Robert S. Anthony

While there are many familiar names in this roundup, a few names are notably absent, mostly because of lineup changes. With the current rush to include local-bus video, flash BIOS, and fast hard disk controllers in even low-priced PCs, many vendors were retooling their assembly lines and could not send machines in time for testing. The expected changes are described below:

COMPUADD

CompuAdd Computer Corp. has introduced the Centura series, a single line aimed at providing top features at low prices. CompuAdd, which filed for Chapter 11 bankruptcy protection, said the units will be available in slimline, desktop, mini-tower, and tower cases.

Local-bus video and hard disk subsystems and Pentium upgrade support are available in all Centura units. The units also include what you might call "Murphy's Law insurance." For one month, CompuAdd will replace a Centura if it is dropped, stolen, burned, or otherwise rendered useless.

PACKARD BELL/ZDS

With its new alliance with Groupe Bull, Packard Bell Electronics hopes to make good use of the OEM capabilities of Zenith Data Systems, a Groupe Bull subsidiary. Packard Bell plans to design and manufacture desktop PCs jointly with ZDS. Groupe Bull, a company owned by the French government, purchased a 19.9 percent interest in Packard Bell, the third-largest PC manufacturer in the U.S.

HYUNDAI

Hyundai Electronics America dove head-first into the direct-sales market last year with more than 60 new aggressively priced machines. Unfortunately, this move failed miserably. Nevertheless, Hyundai is pressing forward with its slim-profile SB, desktop DV, and mini-tower MV series. The DV and MV units come with two VESA VL-Bus slots and offer CPUs ranging from the 486SX/33 to the 486DX2/66. The ISA-based SB series comes with accelerated video and CPUs from the 486SX/25 to the 486DX2/50.

SAMSUNG

Samsung Electronics America has entered the direct-sales channel with its ValuePlus+ PCs. Models SD933V (with a 486DX/33 CPU) and SD966V (with a 486DX2/66 CPU) offer two VESA VL-Bus slots and five ISA slots. The ValuePlus+ SD760V uses a Cyrix Cx486SLC/25 CPU.

DIGITAL EQUIPMENT CORP.

Digital Equipment Corp.'s competitively priced DECpc line is expected to be bolstered with new premium and standard lines this fall. The low-profile LP series and "microtower" MT line offer local-bus video. The units range from the 486SX/25-based 425sx LP to the 486DX2/66-based 466d2 LP and 466d2 MT. □

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"I'm even more attached to my PC, now that it's attached to an AS/400."

A new world is opening up for PC users everywhere—thanks to the IBM AS/400.

With an AS/400 as your server, you'll have access to the information you need to be more productive. Whether you're running DOS, Windows™, OS/2® or Apple's System 7, there's virtually no learning curve for the AS/400, just an interface you're already familiar with. You can even use Novell®'s NetWare® for SAA. And with ShowCase™ VISTA, you can query the AS/400's integrated relational database and view the results graphically.

The AS/400 has the scalability to grow as you grow, with maximum main storage of a whopping 512MB. Plus 20,000 proven business applications from which to choose. And industrial-strength systems management for superior backup, data protection and more.

For reliability, you can't beat the AS/400, with hundreds of thousands of systems installed and running. To learn more about how an AS/400 can make your PC do things you've never dreamed of, call your IBM representative or dial 1-800-IBM-CALL. In Canada, call 1-800-465-1234, ext. 735.

IBM AS/400.
Success Isn't Complicated.

IBM

pentop PCs from Tandy Corp., combines its portable, desktop, and mini-tower PCs under the same brand names. Each brand offers a specific feature set aimed at a certain group of customers. AST's latest is the Premmia P/60 Pentium PC, but neither it nor the new Bravo line were ready for this review.

The Premmia line of high-performance desktops and servers is aimed at the corporate market, with features like highly accelerated local-bus video and large hard disk configurations.

The Advantage! line, sold through retail outlets, is aimed at home-office and small-business users. These units come with preloaded software and business-level hardware features.

Finally, the AST Bravo line is for the budget-conscious PC user, but still offers local-bus graphics, expandable external RAM cache and video memory, and Pentium-level upgrade options. The latest Bravo PCs conform to the EPA's Energy Star guidelines.—*Robert S. Anthony*

Compaq Computer Corp.

Compaq ProLinea 4/33
Compaq Deskpro 4/33i
Compaq Deskpro 486/33M

Compaq Computer Corp. defines many of today's PC marketing standards. Its three product lines (soon to be four) address the entire buying spectrum. The Compaq ProLinea 4/33 is aimed directly at the value market, the Copmpaq Deskpro 486/33M is the high-end family, and the Compaq Deskpro 4/33i is designed to take up everything in between.

Along with a varied product line, Compaq has multiple methods of distribution. You can't buy all products through each distribution channel.

The ProLinea, which has been selling well, thanks to favorable reviews and rock-bottom retail price tags for over a year, recently received a local-bus upgrade—and Compaq has a few more surprises planned down the road.

All ProLineas ship in slimline cases. With only three ISA expansion slots and one empty front-accessible drive bay, there isn't much room to expand. Com-

Benchmark Tests: Value-Line PCs

What the Numbers Mean

Purchasing a high-end desktop system does not guarantee that you'll get top-flight performance. In our benchmark testing of entry-level, midrange, and high-end PCs, we found that careful attention to detail, design, and componentry were the keys to success—and that high price often didn't matter.

PROCESSOR AND MEMORY

All but five of the 22 PC systems we tested contained a static-RAM–based external processor cache. Called a second-level or L2 cache, this fast memory is designed to usher CPU instructions to and from slower dynamic-RAM system memory. While important for most 486 CPUs, an external cache is crucial for top performance from DX2/66 systems because their entire memory subsystems operate at 33 MHz—half the speed of their processors. A cache can make or break CPU performance.

In the case of the Acer Acros, the absence of an optional external cache hampered its performance. At 9,927 processor operations per second, the Acros ran 6 percent faster than the fastest 33-MHz system reviewed, the HP Vectra 486/33XM, which scored 9,360 operations per second. The HP model has a 256K cache—the largest amount in the DX/33 processor group. Acer offers optional caches for all Acros PCs.

The value-oriented Dell Dimension 486/66, running at 17,600 operations per second, was 37 percent faster than average and outperformed the last-place ALR Evolution IV 4/33 by 160 percent. Just on the Dimension's heels was the Dell 466/M, at 17,588 operations per second, and the Northgate ZXP EISA VESA at 17,545 operations per second. The Northgate ZXP contained a 256K four-way set-associative cache, while the two Dells used a 128K direct-mapped cache.

On the average, the 66-MHz systems in this roundup outperformed the 33-MHz units on our processor test by a 90 percent margin. Their memory scores were somewhat unexpected, with both the fastest and slowest systems powered by DX2/66 processors: The NCR System 3350 topped out with a score of 10,390 kilobytes per second (KBps)—about 150 percent better than the slowest unit, the Northgate 486VL, running at 4,123 KBps. Memory scores tracked processor results closely, with all but two of the top ten CPU performers making the top-ten list on our memory test. Each system in the top ten in both the memory and processor categories used a 66-MHz CPU.

DOS DISK AND DISK WINMARK

The most popular hard disk was the Quantum ProDrive LPS 240AT, which came in eight of the systems. Packed with a 256K built-in hardware cache, this Quantum model has a rated access speed of 16 milliseconds but performed closer to those hard disks in this roundup rated at 14 ms. The three Northgate systems included this hard disk, taking fourth through sixth places on our DOS-based hard disk test, each with a score of just under 40 KBps. The ProDrive LPS 240AT's prowess also resulted in the fastest disk scores of the 33-MHz category, on board the Compaq ProLinea 4/33. As adept as this is, the ProDrive ELS 170AT is at the other performance extreme, largely because of its small built-in 32K cache. The three Dell systems contained this drive and lagged in the group.

The real highlight among the tested hard disks was the Seagate ST3600A, which has a 12-ms access time and 256K of built-in cache. The ZEOS 486DX2-66 Upgradable's hard disk performance was almost 31 percent above the average in this roundup.

DOSMARK

As DOSmark scores are heavily weighted for processor and hard disk performance, the ZEOS garnered the first-place position in that category as well. Neither the IBM ValuePoint nor the NCR System 3333 made the top five in processor performance; the ZEOS did, hence its exemplary DOSmark showing. The same correlations are found with the ValuePoint and the System 3333: Each came with a Western Digital Caviar 2340 with a 13-ms access rate; those systems' second- and third-place disk scores, respectively, extended directly to their DOSmark results. The ValuePoint contained the larger built-in hard disk cache, 128K versus 64K in the System 3333.

The three Dell units contained the poorly performing ProDrive ELS 170AT and ranked in the top seven in processor testing, as did the NCR System 3350, which carried a Maxtor LXT340SY. Despite having a 128K built-in cache, the Maxtor LXT340SY put the System 3350 in the same hard disk performance echelon as the Dell units. But the high processor scores of these systems pulled each within the DOSmark top-ten range.

DOS GRAPHICS AND GRAPHICS WINMARK

The fastest Windows accelerators typically produce the slowest DOS video scores. Namely, in this lineup, Weitek's Power 9000 chip set by Weitek—which appeared on two different cards, the Diamond Viper VLB and the Star2000 VL-Bus SVG inside the 486DX2-66 Upgradable and the ZXP EISA VESA, respectively—received the first- and second-place Graphics Winmark scores and ranked second-to-last and last in DOS graphics performance.

Meanwhile, the fastest VGA graphics performer, the Compaq ProLinea 4/33 with a Tseng TC6945AF chip set integrated onto its motherboard, turned in a Graphics Winmark score of 9.36 megapixels per second. This score was impressive, compared with the Graphics Winmark scores of 3.90 and 4.17 megapixels per second produced by the System 3350 and the Gateway 2000 4DX-33, respectively. The Gateway system integrates a Western Digital WD90C31 graphics chip onto the motherboard, while the System 3350 uses NCR's proprietary 77C22E chip set. In both cases, the chips fall short in Windows and DOS video, with scores between 5.15 and 5.40 million operations per second. The average VGA score among the 22 systems was 6.89 million operations per second. The swiftest was the Compaq ProLinea 4/33, with its score of 12.70 million operations per second.

Despite such extremes, there were a few chips in our roundup that performed in the middle range for both Windows- and DOS-based graphics. The best resolution of the competing interests of DOS and Windows video was found on the four systems built around the ATI Mach 32 chip: the AcerPower 486e, the ALR Evolution IV 4/33 and 4E/33, and the Gateway 2000 4DX-33V.

Those systems with Cirrus Logic's CLGD5426 chip set varied so dramatically in both their Graphics Winmark and video scores that drivers are making the performance difference here. The six systems with Cirrus Logic–based video generally did well in VGA graphics—all placed in the top ten, with one exception, the Northgate Superb—and offered average Windows performance. This is a good trade-off if your applications are primarily DOS-based and you use Windows only occasionally.

If your applications reside primarily in Windows but you make frequent treks into DOS, consider a system that incorporates one of two S3 video chips: the P86C805 or the newer P86C928. Both offer strong Windows performance without serious DOS compromise.

All the systems we review offer Graphics Winmark performance in roughly the 10-megapixel-per-second range, with a few clear exceptions. The System 3350 and the Gateway 2000 4DX-33 can safely be called Windows nonperformers, given the lackluster Graphics Winmark ratings generated by their on-board video subsystems. Weitek's Power 9000 chip comes with both the ZXP EISA VESA and the ZEOS. In the former, the P9000 appears on a Star 2000 VL-Bus SVG board and generated an impressive Graphics Winmark score of 35.35 megapixels per second, nearly three times as fast as the average reviewed machine. The clear winner is ZEOS's Diamond Viper VLB card in the ZEOS Upgradable, which turned in an incredible score of 55.01 megapixels per second. Since the P9000 comes only on VL-Bus cards, the Northgate and ZEOS PCs could not have attained these astronomical Graphics Winmark scores if it weren't for their systems' VL-Bus architectures.

DISK WINMARK AND WINDOWS APPLICATIONS

The best performers in Windows-based disk tests correlate well with those that did well on the DOSmark test. These systems, in order of Disk Winmark rank, are the System 3333, the ZEOS, the ValuePoint, and the ZXP EISA VESA. While the DOSmark also takes CPU performance into account, the Disk Winmark score is slightly less compromising to systems with slow hard disks. For example, none of Dell's systems—all of which had excellent processor and memory scores but were hampered by their poorly performing ProDrive ELS 170AT hard disks—made it onto the top-ten list of Disk Winmark scores. Two of Dell's units made the DOSmark top ten, while the 466/M missed it by a hair.

The Windows Applications test results depend on processor, hard disk, and Windows graphics performance. Therefore, those systems that performed well in these three categories showed up regularly in the top five on the Windows Application test suite. Those systems that demonstrated the best agility under strenuous exercise of all their components were the ZXP EISA VESA (32 percent better than average), the ZEOS (26 percent better than average), the System 3333 and the ValuePoint (both 21 percent better than average), and the Dell Dimension (20 percent better than average). It is interesting to note that this is a mix of both high- and low-end systems.

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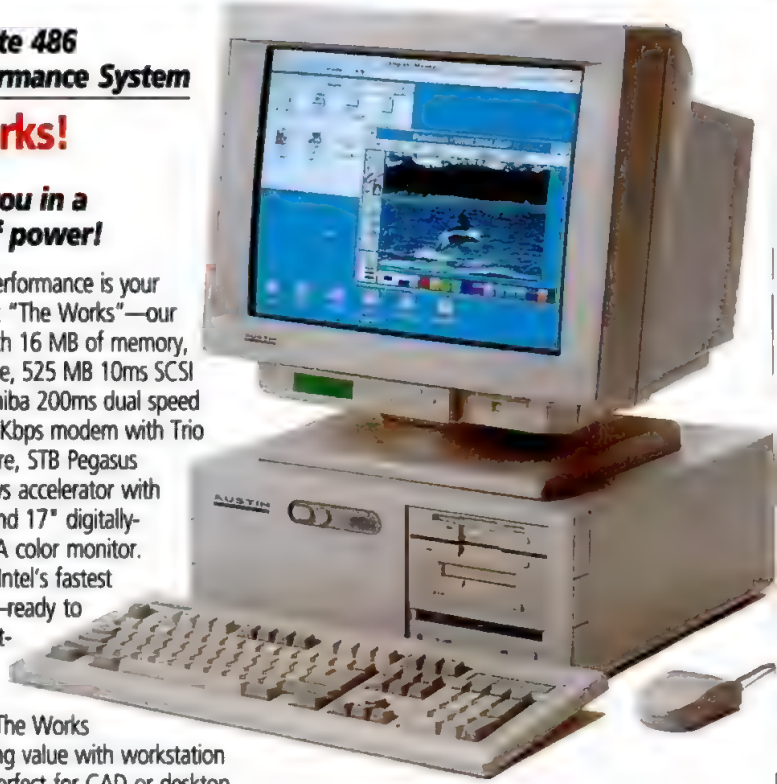

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Desktop Case with Three 5.25" HH Bays, Two Internal 3.5" HDD Bays and 200 Watt High Efficiency Power Supply

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Choice of High Performance IDE and SCSI Hard Drives
Sony 31A CD-ROM Drive
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STB Powergraph VL24 VL-bus 1 MB Windows Accelerator
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486DX2-66	424 MB IDE 13ms	2,999

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14" Super VGA Color Monitor
Desktop Case with Three 5.25" HH Bays, Two Internal 3.5" HDD Bays and 200 Watt High Efficiency Power Supply

486SX-25	14" SVGA	212 MB	$ 1,449
486SX-33	14" SVGA	212 MB	1,499
486DX-33	14" NI SVGA	250 MB	1,789
486DX2-50	14" NI SVGA	340 MB	1,899
486DX2-66	14" NI SVGA	340 MB	2,149

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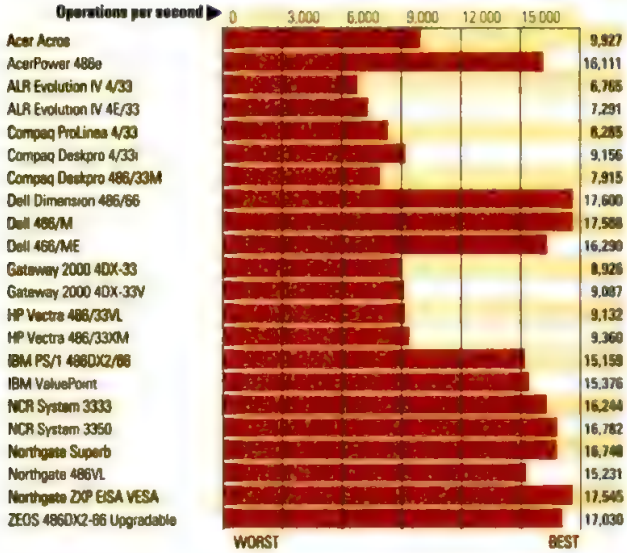
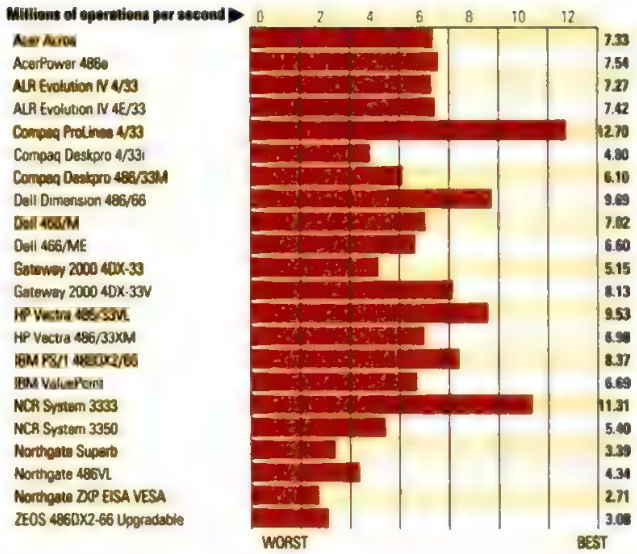
CIRCLE 012 ON READER SERVICE CARD

Benchmark Tests: Value-Line PCs

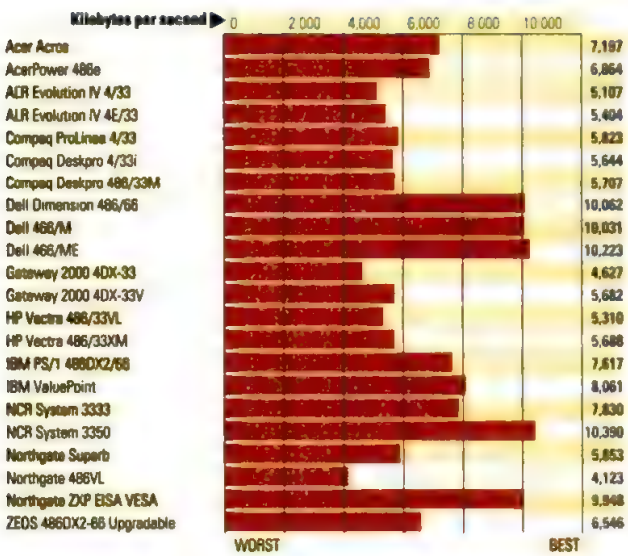
PROCESSOR



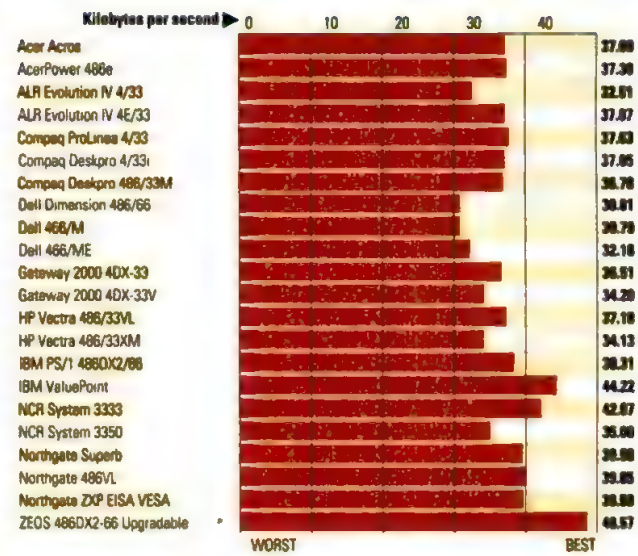
VIDEO



MEMORY



DISK



How We Tested

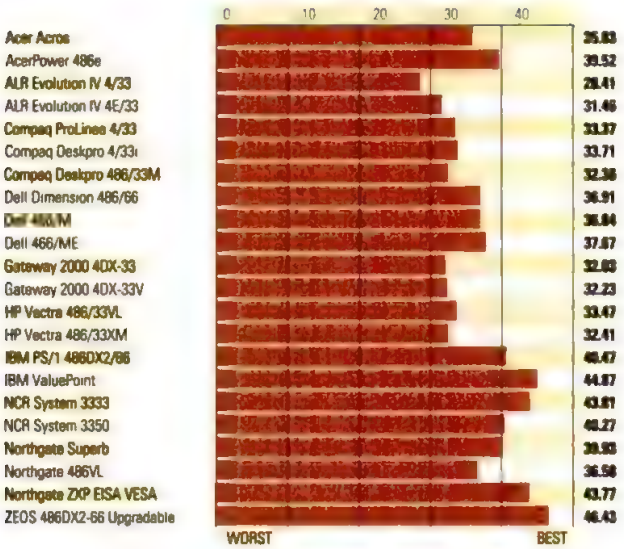
In preparing this issue we used PC Magazine Labs' Hardware Benchmark Tests, Release 7.01, to predict PC processor, memory, video subsystem, and disk performance using DOS applications. Each of the four scores we report is the weighted harmonic mean of the results from several tests, expressed either in terms of throughput or in operations per second. All of these results are summarized in a composite score called the DOSmark.

We also used the Windows Benchmark Tests (Winbench), Release 3.11, to obtain the Graphics Winmark and Disk Winmark scores, and used the Windows Applications tests to simulate a multitasking environment. All of these tests predict relative performance levels using popular Windows applications.

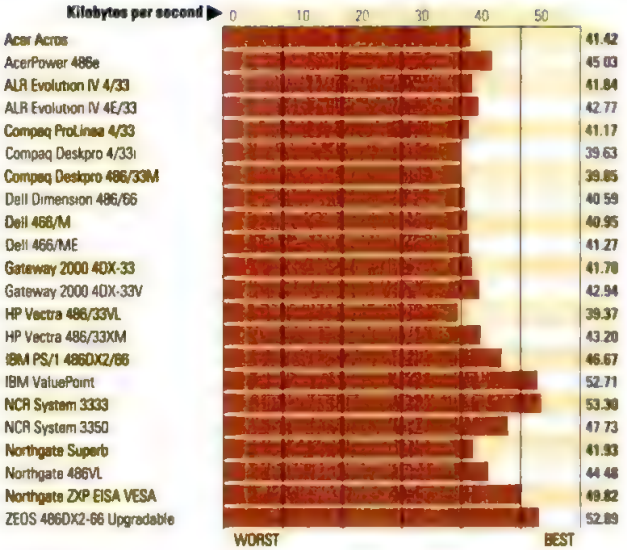
The **processor** score is a measure of the CPU's performance and its interaction with cache and main memory. It is derived from tests that use small and medium-size instruction mixes, along with either the floating-point calculation test or the coprocessor test (depending on the presence or absence of a math coprocessor). The score indicates how well the CPU and cache subsystems would execute common DOS and Windows applications.

The **memory** score is compiled from 8-, 16-, and 32-bit extended-memory read and write tests, as well as 8- and 16-bit conventional-memory read and write tests.

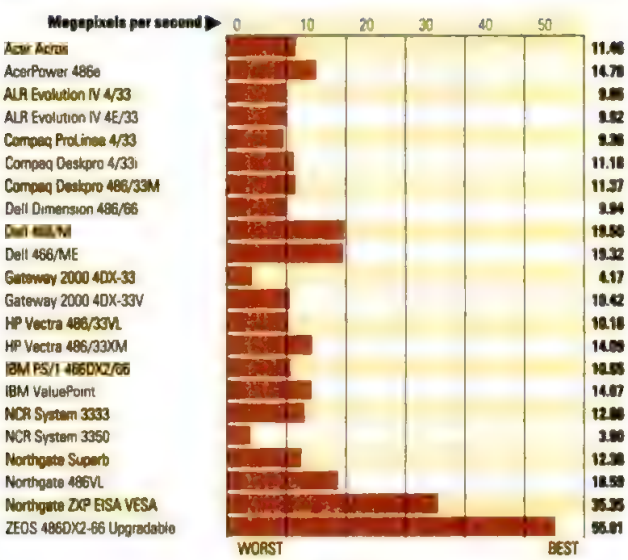
DOSMARK



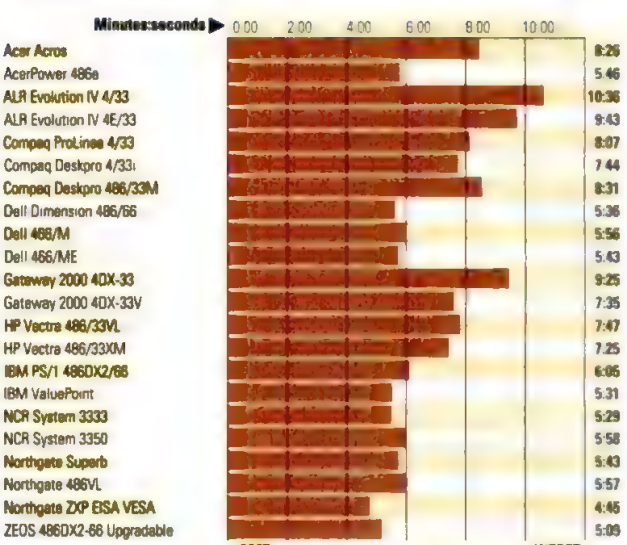
DISK WINMARK



GRAPHICS WINMARK



WINDOWS APPLICATIONS



The **disk** score measures throughput using standard DOS INT 21h file I/O calls. The tests measure the speed of file reading and writing, both sequentially and randomly, for a range of file sizes from 256K to 32MB. The tests are performed without software disk caches installed.

The **video** score is based on direct-to-screen text-write and graphics-write tests. Together, these tests reflect the video throughput for a standard EGA/VGA adapter running DOS applications.

The **DOSmark** score is a composite rating derived from the processor, memory, video, and disk test scores. The DOSmark indicates a PC's ability to run DOS applications.

The **Graphics Winmark** score is based on 12 Windows graphics and text functions derived from extensive profiling of popular Microsoft Windows applications. The score is expressed in megapixels per second (a megapixel is defined as 1,048,576 pixels).

The **Disk Winmark** score is based on testing techniques adapted from the DOS disk tests to reflect operations within the Windows environment. For this portion of the testing, the systems were configured with up to 2MB of SmartDrive cache.

The **Windows Applications** suite measures the PC's operation in a multitasking environment. Portions of four popular programs—Ami Pro, CorelDRAW, Microsoft Excel, and Superbase—are run via a macro and are timed.

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CIRCLE 377 ON READER SERVICE CARD

paq shipped all three machines to us with its new and impressive 151FS monitor—a 15-inch affair with digital front-mounted controls. It will run you about $100 more than the 14-inch Compaq display generally sold with this system.

Our only criticism of the ProLinea family of PCs is the on-board video chip set. The local-bus feature is nice, but the choice of a Tseng chip set hurt the ProLinea's Windows performance. The lack of any external processor cache options for the ProLinea could hurt performance when using a DX2/66 processor.

The Deskpro/i line is aimed at the midrange corporate buyer. In fact, similarly equipped Deskpro/M and Deskpro/i PCs can cost the same, because what is a basic price for the former line is an option-loaded latter. For instance, the Deskpro/i ships with 512K of video DRAM, though we asked for 1MB. As configured it was quite a competitive machine. Our only request might be for a larger case with more drive bays; the slimline configuration just doesn't offer enough room for advanced users.

The Deskpro/M line is justly famous, mainly for being one of the best designed and engineered computers you can buy: It has won several Editors' Choice awards in the past year. It houses much of Compaq's investment into PC R&D, including the QVision EISA video card, and from its inception has been designed to upgrade easily across any Intel CPU platform, including Pentium. In fact, in *PC Magazine*'s last look at Pentium PCs ("Pentium PCs: The New Standard," June 29, 1993), the Deskpro/M was one of the few we reviewed.

With their small-footprint desktop cases and five EISA expansion slots, Deskpro/M systems have enough room for future expansion. Among their many features, Deskpro/M systems also carry on-board audio on systems that ship with Windows preinstalled. Compaq calls this Business Audio and supplies input and output jacks as well as a microphone that

Compaq

VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE

ProLinea 4/33

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	FAIR
Expandability	POOR

Deskpro 4/33i

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	FAIR
Expandability	POOR

Deskpro 486/33M

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	FAIR
Expandability	FAIR

FACT FILE

Compaq ProLinea 4/33

Estimated price (tested configuration): $2,319.

Memory and processor RAM cache: 8MB 70-ns SIMMs.

Disk drives and controller: Quantum ProDrive LPS 240AT 16-ms 245MB IDE hard disk with 256K cache, integrated disk controller, 1.44MB floppy disk drive.

Display: Compaq integrated video controller with 1MB DRAM, Compaq 151FS 15-inch monitor with a 72-Hz refresh rate at 1,024-by-768.

Software: DOS 6.0, Microsoft Windows 3.1, Compaq Business Audio.

Compaq Deskpro 4/33i

Estimated price (tested configuration): $3,089.

Memory and processor RAM cache: 8MB 80-ns SIMMs, 64K external cache.

Disk drives and controller: Same as ProLinea.

Display: Same as ProLinea, except VRAM, not DRAM.

Software: Same as ProLinea.

Compaq Deskpro 486/33M

Estimated price (tested configuration): $3,089.

Memory and processor RAM cache: 8MB 80-ns SIMMs.

Disk drives and controller: Same as ProLinea.

Display: Compaq QVision 1024/E EISA card video controller with 1MB VRAM, Compaq 151FS 15-inch monitor with a 72-Hz refresh rate at 1,024-by-768

Software: Same as ProLinea

In short: All three Compaq units were solid performers, with the ProLinea offering a good value and the two Deskpros providing ample expandability.

Compaq Computer Corp., P.O. Box 692000, Houston, TX 77269-2000; 800-345-1518, 713-370-0670; fax, 800-345-1518.

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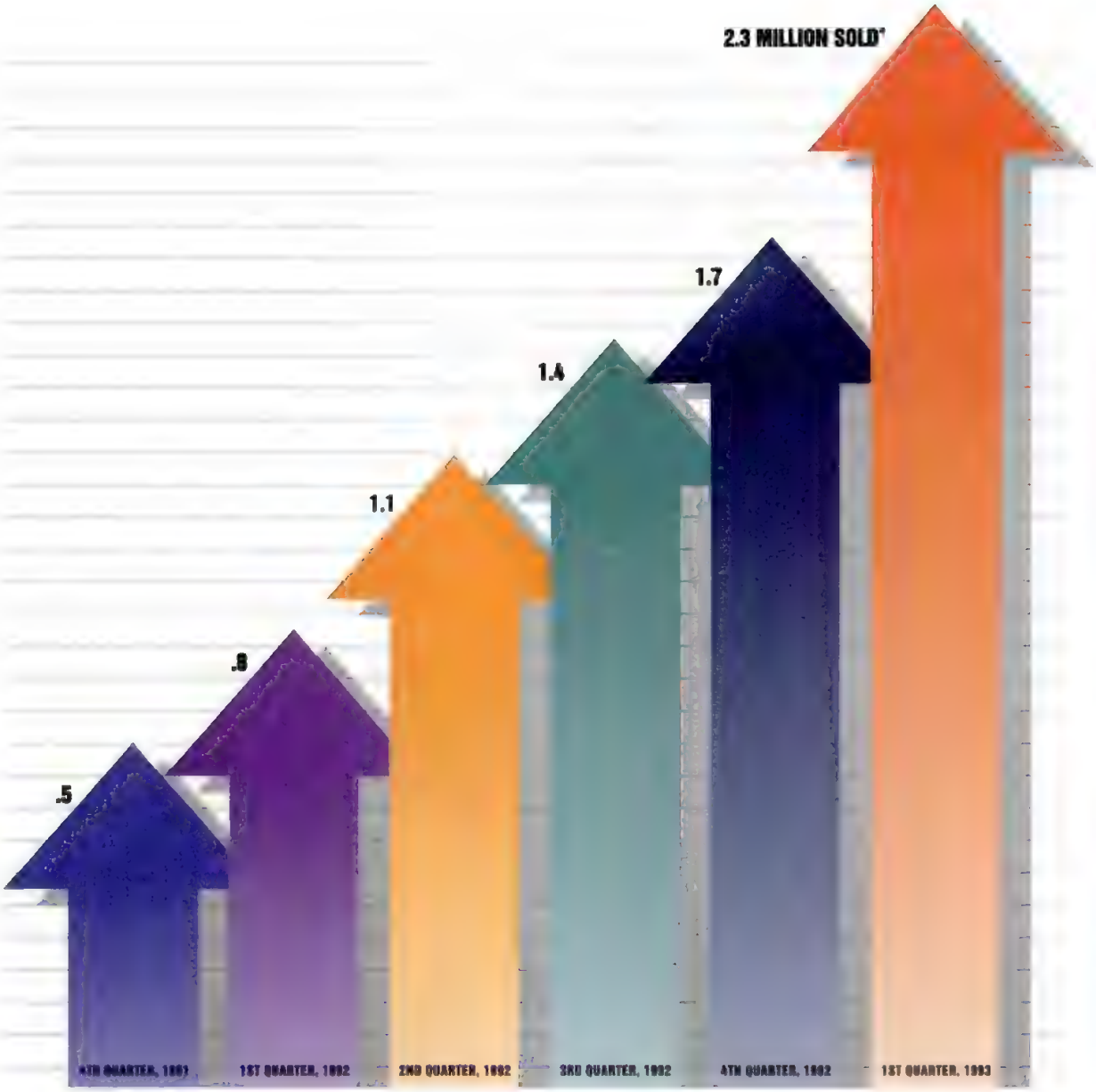

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can mount on your monitor. Simply attach some speakers or headphones and you have the ability to run rudimentary multimedia, like voice annotations to a spreadsheet. Another pleasing feature is that main memory and the processor sit on proprietary plug-in cards. Though a new processor card can be expensive, upgrading it merely means pulling out the old card and plugging in the new one. With all this going for it, you can easily see how the Deskpro/M has become the power user's machine of choice.

With small-footprint cases and five EISA expansion slots, Deskpro/M systems have enough room for future expansion.

Performance for the three Compaqs was typical: very solid with few results straying either far up or down the scale. The ProLinea's Tseng chip–based local-bus video captured first place on DOS video but fell under the Windows environment. Compaq included 486DX/33 processors in all three machines; each performed competitively in this class, and the Deskpro/i excelled slightly.

All Compaq PCs have a three-year parts-and-labor warranty; the first year includes free on-site service from various service vendors.—*Oliver Rist*

Dell Computer Corp.

Dell Dimension 486/66
Dell 466/M
Dell 466/ME

Dell Computer Corp.'s primary response to the computer industry's trend toward multiple product lines aimed at different buyers has been the low-cost Dimension line. The systems Dell supplied for this review cover the low end, middle, and high end of the market.

Dell	
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE

Representative of their families, each system contains an Intel 486DX2/66 processor. A pleasant surprise was that all three systems support local-bus graphics on the motherboard. Remote diagnostics is one area where the lines diverge. Dell's midrange and high-end PC lines, the Dell 466/M and Dell 466/ME models, contain systems with embedded diagnostic functions, while the Dimension family does not. These diagnostic programs are stored in flash memory on the system board, with a back-up copy kept on the hard disk. They can thus be run even when major system components have failed.

Dell is targeting the Dimension line at users who are on a budget but still need a full-featured machine. All Dimension systems come with four front-accessible drive bays, a 200-watt power supply, six standard ISA slots, and a motherboard with integrated I/O ports—many features expected only on high-end systems.

The Dimension's local-bus technology is restricted to the on-board video based on a Cirrus Logic chip set that performed well in DOS-based video compared with other Dell systems. PC Magazine Labs' test configuration, which included a 170MB Quantum hard disk, two floppy disk drives, a small-footprint desktop case, a 128K external cache, and a 14-inch multiscanning monitor, costs $2,568 and is available at many retail outlets. As with most Dell products, this machine comes with crystal-clear manuals that cover all the bases.

Performance for the Dimension was uneven; it placed first on our processor and memory tests but lagged on our disk and Windows video tests. The graphics results can be attributed to the Cirrus Logic chip set, but the disk scores are a common problem across all three Dell machines. Apparently, Dell's on-board hard disk controller circuitry was the weak link.

By contrast, the 466/M and 466/ME are two members of the same family.

FACT FILE

Dell Dimension 486/66

List price (tested configuration): $2,568

Memory and processor RAM cache: 8MB 70-ns SIMMs, 128K external cache.

Disk drives and controller: Quantum ProDrive ELS 170AT 17-ms 168MB IDE hard disk with 32K cache, integrated disk controller, 1.2MB and 1.44MB floppy disk drives.

Display: Integrated local-bus video controller with 1MB DRAM, Dell DL-1460NI 14-inch monitor with a 70-Hz refresh rate at 1,024-by-768.

Software: DOS 6.0, Microsoft Windows 3.1.

Dell 466/M and 466/ME

List price: 466/M, $3,318; 466/ME, $3,667.

Memory and processor RAM cache: 8MB 70-ns SIMMs, 128K external cache

Disk drives and controller: Same as Dimension 486/66, except with dual 1.2MB/1.44MB floppy disk drive.

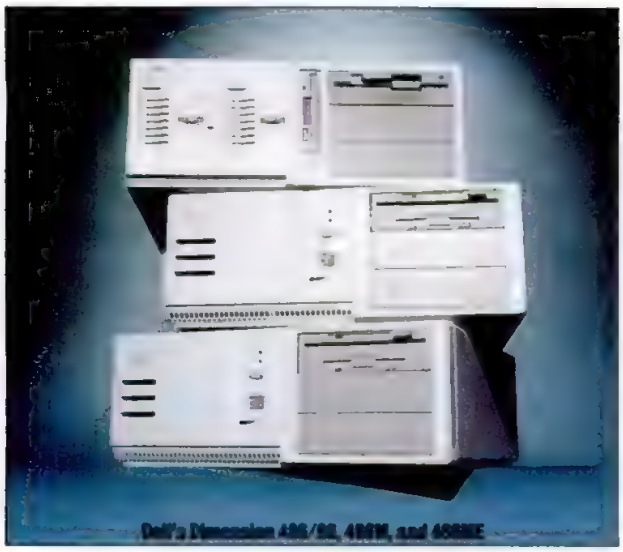
Display: Integrated local-bus video controller with 1MB DRAM, Dell Ultrascan 14C 14-inch monitor with a 70-Hz refresh rate at 1,024-by-768

Software: DOS 6.0, Microsoft Windows 3.1.

In short: Of Dell's three lines, the Dimension appears to be the best buy, but disappointing disk performance plagued these systems.

Dell Computer Corp., 9505 Arboretum Blvd., Austin, TX 78759; 800-289-3355, 512-338-4400; fax, 512-343-3643.

474 ON READER SERVICE CARD



Both come with the same manual, but they are based on different motherboards. They are aimed at high-end PC users and corporate customers looking for powerful workstations. The $3,318 466/M is an ISA-based PC, while the 466/ME is EISA-based. Both contain local-bus video, and each of our test units came in a desktop-size case with a 224-watt power supply, a dual 1.2MB/1.44MB floppy disk drive, a 162MB Quantum IDE hard disk, a 128K external cache, and a 14-inch Ultrascan 14C monitor. Our wish list for these two units includes a larger and upgradable external cache, an optional 15-inch monitor, upgradable VRAM that goes beyond 1MB, and a ZIF processor socket.

Dimension 486/66

SUITABILITY TO TASK	
DOS applications	EXCELLENT
Windows applications	GOOD
Expandability	FAIR

Performance for these machines was noteworthy, but considering the higher price tags, they really didn't outclass the Dimension by much. The Dimension beat both the 466/M and the 466/ME on our processor test; the 466/M

On the Road, At the Office

For the multitude of businesspeople who divide their time between hotel rooms, airliners, and their offices, matching the right PC with the right data can be a difficult balancing act. While utilities such as LapLink can help by synchronizing and updating files, the notion that one PC may be able to cover all the bases is appealing. In theory, the combination of a laptop and a docking station can be thought of as an additional type of PC that is flexible enough to do double duty at the office and on the road.

Today, a powerful portable with a high-quality color screen should be able to satisfy even the most MIPS-hungry power users. A docking station can provide access to network connections, multimedia extensions, standard video, and other features dependent on expansion slots and drive bays. We looked at two laptops that are making inroads on the desktop: the Compaq LTE Lite 4/33C and the IBM ThinkPad 720C. The Compaq system, which U.S. buyers purchase with an expansion unit 30 percent of the time, was set up with its Expansion Base and a QVision monitor. The purchase rate of IBM's 3550 Expansion Unit is a bit lower. Because the ThinkPad has an exceptionally bright, 10.4-inch active-color screen, we set up the IBM portable with just the expansion unit, using its color panel as the native display.

SIDE BY SIDE

Performance for both units is top notch by notebook standards, but merely average by desktop standards. The Compaq has a slight edge in processor-intensive tasks because of its 486DX/33 CPU, which contains a built-in floating-point unit and 8K of internal cache. By contrast, IBM's 486SLC2/50 operates quicker internally and has twice as much internal cache, but doesn't have a floating-point unit. Compaq bases its unit on a standard ISA bus, while IBM uses its own Micro Channel bus.

Both units offer two expansion slots; the IBM also offers two half-height accessible bays, while the Compaq offers a half-height and a one-third-height accessible bay. The Compaq also has a pass-through phone connector, with jacks on the side of the expansion base so that the notebook's modem quickly becomes the desktop's modem. The IBM expansion unit has the advantage in peripheral connection because of its built-in SCSI adapter that accommodates up to seven peripherals.

The major shortcoming continues to be in video. Both units can handle VGA video, but their Graphics Winmark scores are no better than 2 and 5 megapixels per second for Compaq and IBM, respectively. By contrast, the best desktop video systems today can achieve a level ten times as high.

LOOK AND FEEL

It is in the unquantifiable areas of ergonomics and design where the units truly set themselves apart. The most stark difference is in look. While the Compaq is standard PC beige, IBM outfits its unit in sleek, basic black. Both notebooks slide easily into place and release via a push button, and both docking stations have locks to ensure that the notebooks stay put when docked. But neither unit is conceptually as neat as Macintosh's Duo Dock (see "Double-Duty Duo," *PC Magazine*, March 30, 1993). Not only is the Duo exceptionally light, but the docking station pulls the notebook in and saves data on ejection.

As far as price goes, there's no contest between these hybrid systems and standard desktop units; both the IBM and Compaq sell for roughly $5,000 each—nearly twice what a comparable desktop system would cost. Even at that price, upgrading memory is more difficult and expensive, and you'll be limited to two expansion slots, just enough for network and video cards.
—*Brian Nadel*

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came in second and the 466/ME came in seventh. On the other hand, the high-end Dell systems did much better on our Windows tests than the Dimension did. The constant in these tests was the poor disk scores in both Windows and DOS for all the Dell systems. Dell offers all of its products with a one-year parts-and-labor warranty that includes a year of on-site service, toll-free technical support, and a technical-support BBS.—*OR*

466/M

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	GOOD
Expandability	FAIR

466/ME

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	GOOD
Expandability	FAIR

Gateway 2000

Gateway 2000 4DX-33
Gateway 2000 4DX-33V

South Dakota–based Gateway 2000 arguably sells more computers by mail order than any other company in the United States. Gateway offers two types of systems that are part of the same line: a mini-desktop ISA system, and a full-size desktop ISA system with a VESA local bus. Since Gateway's sales growth, led by its successful 66-MHz DX2-66V in a full-size case, is expanding rapidly, the company has little impetus to add more lines.

Gateway 2000

VENDOR SERVICE & RELIABILITY	
Reliability	AVERAGE
Repair service	ABOVE AVERAGE
Technical support	AVERAGE

Scoring high for service and support in the *PC Magazine* Service and Reliability Survey, Gateway continues to direct its efforts toward growing its technical support staff to match unit sales numbers. In the coming year, Gateway also expects to include more multimedia features (70 percent of its DX2/66 systems are now sold with CD-ROM drives) and incorporate power management into its models.

The Gateway mini-desktop line is rep-

▶ SUMMARY OF FEATURES CONTINUES

Value-Line vs. Traditional PCs

List price (tested configuration) Unless specified, all prices are list prices for machines as tested by PC Magazine Labs. Some vendors are moving away from set list prices and are using estimated selling prices instead to reflect what a customer would pay.

Dealers/Direct-distribution channel Various machines are sold directly through mail order, through dealers, or, increasingly, through company-owned stores and superstores. For machines sold through dealers, *PC Magazine* views a 15 percent discount off the suggested retail price as typical.

The **chip set manufacturer** makes the logic that connects the CPU with the other functions managed by the system board.

The **processor upgrade path** indicates whether the PC has a standard, ZIF (zero-insertion-force), or LIF (low-insertion force) socket, or whether you must use a processor card to perform an upgrade.

The **BIOS version (or date)** can affect the system's performance on PC Magazine Labs' benchmark tests. A PC with another BIOS may perform differently.

Flash memory contains BIOS code that can be updated via software. The BIOS is generally stored in conventional ROM, which has no provision for modification.

Installable RAM on motherboard indicates the amount of memory that can be installed using any combination of chips and proprietary cards.

Cache architecture A *four-way set-associative* cache, native to the 486's internal 8K cache, divides data into four equal blocks; it is considered the most effective type of cache. A *two-way set-associative* cache's data is split into two equal blocks, and the data in a *direct-mapped* cache (the most common and least costly type) is not divided.

Cache write design A *write-back* design can cache data read from and written to memory. This is theoretically superior to that of a *posted write-through* cache, which buffers all writes until the system bus is free before completing them, and that of a *write-through* cache, in which only reads from memory are cached.

Accessible drive bays can be reached from the system's front panel and can support removable media (such as tape and CD-ROMs); **internal drive bays** can be reached only by opening the case. We report the maximum number of accessible and internal drives the system can hold.

Floppy disk drives We report the types of floppy disk drives each tested system contains. A *dual* floppy disk drive combines a 1.2MB and a 1.44MB unit inside a single drive bay.

Hard disk options We report the range of hard disk capacities the vendor offers for each system.

Disk controller location The disk controller can reside on an ISA, EISA, or local-bus expansion card or on the PC's motherboard.

Expansion bus For each type of expansion slot—8-bit, 16-bit, and 32-bit EISA/MCA, and 32-bit proprietary—we report the number of slots on the motherboard. We also report the number of VESA, PCI, and proprietary bus slots each unit offers, and indicate how many parallel, serial, and mouse ports are integrated onto the motherboard.

The **display circuitry** can reside on an expansion card or on the PC's motherboard. Motherboard circuitry is often faster, but if it cannot be disabled there is no way to upgrade it. We are also seeing an increasing number of video systems that rely on local-bus connections. We expect to see PCI systems in the near future.

DOS 6.0/Microsoft Windows 3.1 included We indicate whether these software packages come as part of a standard bundle with the base-priced system. Where the software is not included in the standard bundle, it may be available at extra cost.

The **first-year on-site service charge** may be included in the price of the system, or it may be a set or variable added cost. If the charge varies, it is often determined by the system's configuration and cost.

FCC Class B identification number Systems with a Class B rating from the Federal Communications Commission have sufficiently low radio-frequency emissions to be used in the home.

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37. SCALABLE FONTS For the sharpest, clearest typefaces possible, WordPerfect 6.0 displays and supports TrueType™, CG Intellifont, Bitstream Speedo™ and Type 1 font technologies.

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86. EXPANDED WINDOWING These days, nobody has the luxury of working on one thing at a time. WordPerfect 6.0 lets you open and edit up to nine documents at once.

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143. ENVELOPES & BAR CODES Addressing envelopes and labels is about as fun as licking stamps. But now you can do it automatically, even adding bar codes to speed the mail along.

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▶ SUMMARY OF FEATURES

Value-Line PCs

Products listed in alphabetical order

■ = YES □ = NO

PC family line:
■—Low-end ■—High-end

	Acer Acros	AcerPower 486e	ALR Evolution IV 4/33	ALR Evolution IV 4E/33	Compaq ProLinea 4/33	Compaq Deskpro 4/33i
List price (tested configuration)	$2,499	$2,995	$2,889	$3,096	$2,319 (estimated)	$3,089 (estimated)
Processor type	Intel 486DX2/66	Intel 486DX2/66	Intel 486DX/33	Intel 486DX/33	Intel 486DX/33	Intel 486DX/33
Hard disk capacity	244MB	244MB	255MB	255MB	245MB	245MB
Dealers/Direct-distribution channel	■□	■□	■■	■■	■■	■■
Case style	Small-footprint	Desktop	Small-footprint	Small-footprint	Slimline	Slimline
Bus architecture	ISA	EISA	ISA	EISA	ISA	ISA
Power supply (and number of connectors)	145W (4)	200W (4)	200W (4)	200W (4)	150W (4)	146W (4)
Motherboard and CPU						
Motherboard manufacturer	Acer	Acer	ALR	ALR	Compaq	Compaq
Chip set manufacturer	Acer	OPTi	OPTi	OPTi	VLSI	Intel, Motorola
Processor upgrade path	Standard socket	Standard socket	ZIF socket	ZIF socket	Standard socket	Standard socket
BIOS version (or date)	Acer (6/11/93)	Acer 1.2	Phoenix (4/19/93)	Phoenix (4/24/93)	Compaq (2/18/93)	Compaq (5/18/93)
Flash memory	□	■	■	■	□	■
Memory and Processor RAM Cache						
Installable RAM on motherboard	4MB–68MB	4MB–256MB	4MB–52MB	4MB–256MB	4MB–32MB	4MB–32MB
Installed external RAM cache	None	128K	None	None	None	64K
Cache architecture	N/A	Direct-mapped	N/A	N/A	N/A	Two-way set-associative
Cache write design	N/A	Write-back	N/A	N/A	N/A	Write-through
Disk Drives						
Accessible drive bays (5.25", 3.5")	2, 1	3, 1	2, 1	2, 1	1, 1	1, 1
Internal drive bays (5.25", 3.5")	0, 1	0, 2	0, 1	0, 1	0, 1	0, 1
Floppy disk drives	1.2MB, 1.44MB	1.2MB, 1.44MB	1.44MB	1.44MB	1.44MB	1.44MB
Hard disk options	240MB–340MB	240MB–520MB	170MB–340MB	170MB–340MB	84MB–1GB	84MB–1GB
Disk controller location	Motherboard	ISA card	Motherboard	Motherboard	Motherboard	Motherboard
Expansion Bus						
8-bit, 16-bit, 32-bit slots	0, 2, 0	0, 2, 4	0, 3, 0	0, 0, 3	0, 3, 0	0, 3, 0
VESA, PCI, proprietary slots	2, 0, 0	0, 0, 1	2, 0, 1	2, 0, 1	None	None
Parallel, serial, mouse ports on motherboard	1, 2, 1	1, 2, 0	1, 2, 1	1, 2, 1	1, 2, 1	1, 1, 1
Integrated network adapter option	None	None	None	None	None	Ethernet
Video						
Display circuitry location	Motherboard local bus	Proprietary local-bus card	VL-Bus card	VL-Bus card	Motherboard local bus	Motherboard
Video chip set manufacturer	Cirrus Logic	ATI	ATI	ATI	Tseng	Compaq
Miscellaneous						
DOS 6.0/Microsoft Windows 3.1 included	■■	■■	■■	■■	■■	■■
Warranty	1 year	1 year	5 years parts, 15 months labor	5 years on parts, 15 months on labor	3 years	3 years
On-site service charge	Included (1 year)	Included (1 year)	$9.95 (1 year)	$9.95 (1 year)	Included (1 year)	Included (1 year)
FCC Class B identification number	GQ8PZ25DA-Z1	GQ8P433WE	E7Y8805486	E7Y8305486	CNT75MBF5	CNT75MBFE

N/A—Not applicable: The product does not have this feature. ALR—Advanced Logic Research Inc., AMI—American Megatrends Inc., ATI—ATI Technologies Inc., C&T—Chips & Technologies Inc., SIS—Silicon Integrated Systems Corp., TI—Texas Instruments Inc., UMC—United Microelectronics Corp., VLSI—VLSI Technology Inc., WD—Western Digital Corp.

CONTINUES

Compaq Deskpro 486/33M	Dell Dimension 486/66	Dell 466/M	Dell 466/ME	Gateway 2000 4DX-33
$3,089 (estimated)	$2,568	$3,318	$3,667	$2,070
Intel 486DX/33	Intel 486DX2/66	Intel 486DX2/66	Intel 486DX2/66	Intel 486DX/33
245MB	170MB	162MB	162MB	212MB
■■	■■	■■	■■	□■
Small-footprint	Desktop	Desktop	Desktop	Slimline
EISA	ISA	ISA	EISA	ISA
240W (5)	200W (4)	224W (4)	224W (4)	200W (6)
Compaq	Dell	Dell	Dell	TI
Motorola	Headland	Headland	Intel	OPTi
Processor card	Standard socket	Standard socket	Standard socket	ZIF socket
Compaq (5/21/92)	Phoenix 1.10 A03	Phoenix (5/18/93)	Phoenix (1/25/93)	Phoenix (4/19/90)
■	■	■	■	■
8MB–64MB	4MB–64MB	4MB–64MB	4MB–64MB	8MB–64MB
None	128K	128K	128K	64K
N/A	Direct-mapped	Direct-mapped	Direct-mapped	Direct-mapped
N/A	Write-through	Write-through	Write-through	Write-back
3, 0	3, 1	3, 0	3, 0	1, 1
0, 2	0, 1	0, 1	0, 1	0, 1
1.44MB	1.2MB, 1.44MB	Dual	Dual	1.2MB, 1.44MB
60MB–1GB	170MB–450MB	80MB–500MB	80MB–500MB	80MB–1.2GB
Motherboard	Motherboard	Motherboard	Motherboard	Motherboard
0, 0, 5	0, 6, 0	0, 6, 0	0, 2, 4	0, 5, 0
None	None	0, 0, 1	0, 0, 1	None
1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 1
None	None	None	None	None
EISA card	Motherboard local bus	Motherboard local bus	Motherboard local bus	Motherboard
Compaq	Cirrus Logic	S3	S3	WD
■■	■■	■■	■■	■■
3 years	1 year	1 year	1 year	1 year
Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)
CNT75MBD7	E2K486WKM	E2K486M	E2K486ME	HWYLP486I2

resented for this review by the $2,070 Gateway 2000 4DX-33 that came with 8MB of RAM, a 64K standard RAM cache, a 212MB IDE hard disk, two floppy disk drives, an integrated Western Digital video accelerator chip, a 15-inch Super VGA monitor, and a modem. All the controller components are integrated onto the motherboard except the modem. This line's CPU options range from a 486SX/25 to the tested 486DX/33.

Both the 4DX-33 and the Gateway 2000 4DX-33V came with Gateway's 15-inch CrystalScan monitor, which supports 1,280-by-1,024 interlaced resolution. However, the 4DX-33's resolution is limited by the Western Digital controller, which can display a maximum 1,024-by-768 noninterlaced resolution. The system had the second-slowest Windows video scores; it was the slowest of the

▶ FACT FILE

Gateway 2000 4DX-33

List price (tested configuration): $2,070 (includes Telepath data/fax modem).

Memory and processor RAM cache: 8MB 70-ns SIMMs, 64K external cache.

Disk drives and controller: Western Digital Caviar 2200 13-ms 212MB IDE hard disk with 64K cache, integrated disk controller, 1.2MB and 1.44MB floppy drives.

Display: Integrated video controller with 1MB VRAM, Gateway 2000 CrystalScan 1572FS 15-inch monitor with a 76-Hz refresh rate at 1,024-by-768.

Software: DOS 6.0, Windows 3.1, MS Works 2.0.

Gateway 2000 4DX-33V

List price (tested configuration): $2,363 (includes Telepath data/fax modem).

Memory and processor RAM cache: 8MB 70-ns SIMMs, 64K external cache.

Disk drives and controller: Same as 4DX-33.

Display: Same as 4DX-33, except with ATI Graphics Ultra Pro VESA local-bus card video controller with 1MB VRAM.

Software: DOS 6.0, Microsoft Windows 3.1, choice of application software.

In short: Gateway 2000's DX mini-desktop series is a fine starter machine, but the company's full-size DV local-bus desktop system is by far the better value.

Gateway 2000, 610 Gateway Dr. N. Sioux City, SD 57049; 800-846-2000, 605-232-2000; fax, 605-232-2023.

ON READER SERVICE CARD

SUMMARY OF FEATURES

PC family line:

Products listed in alphabetical order

■—Low-end —High-end

■ = YES □ = NO

	Gateway 2000 4DX-33V	HP Vectra 486/33VL	HP Vectra 486/33XM	IBM PS/1 486DX2/66	IBM ValuePoint	NCR System 3333
List price (tested configuration)	$2,363	$2,856	$3,676	$2,500 (estimated)	$3,109 (estimated)	$2,995 (estimated)
Processor type	Intel 486DX/33	Intel 486DX/33	Intel 486DX/33	Intel 486DX2/66	Intel 486DX2/66	Intel 486DX2/66
Hard disk capacity	212MB	244MB	244MB	255MB	340MB	340MB
Dealers/Direct-distribution channel	□■	■□	■□	■■	■■	■■
Case style	Desktop	Small-footprint	Desktop	Mini-tower	Desktop	Mini-tower
Bus architecture	ISA	ISA	ISA	ISA	ISA	ISA
Power supply (and number of connectors)	200W (7)	75W (4)	75W (4)	205W (6)	145W (5)	200W (5)
Motherboard and CPU						
Motherboard manufacturer	Micronics	HP	HP	IBM	IBM	NCR
Chip set manufacturer	Micronics	VLSI	VLSI	VLSI	IBM	UMC
Processor upgrade path	OverDrive socket	Standard socket	OverDrive socket	None	ZIF socket	ZIF socket
BIOS version (or date)	Phoenix 0.10 GJX30-05E	AMI (11/11/92)	Phoenix (5/19/93)	IBM (1/22/93)	IBM (4/28/93)	IBM 1.00.00
Flash memory	■	□	■	□	■	■
Memory and Processor RAM Cache						
Installable RAM on motherboard	4MB–64MB	4MB–32MB	4MB–64MB	8MB–64MB	2MB–64MB	2MB–64MB
Installed external RAM cache	64K	128K	256K	128K	128K	64K
Cache architecture	Direct-mapped	Direct-mapped	Direct-mapped	Direct-mapped	Two-way set-associative	Direct-mapped
Cache write design	Write-through	Write-back	Write-back	Write-back	Posted write-through	Write-back
Disk Drives						
Accessible drive bays (5.25", 3.5")	3, 0	2, 0	1, 1	2, 2	2, 1	2, 2
Internal drive bays (5.25", 3.5")	2, 0	2, 0	2, 0	0, 2	0, 1	0, 2
Floppy disk drives	1.2MB, 1.44MB	1.44MB	1.44MB	1.2MB, 1.44MB	1.44MB	1.44MB
Hard disk options	80MB–1.2GB	120MB–450MB	120MB–1GB	255MB	245MB–527MB	80MB–1GB
Disk controller location	Motherboard	Motherboard	Motherboard	Motherboard	Motherboard	Motherboard
Expansion Bus						
8-bit, 16-bit, 32-bit slots	0, 5, 0	0, 4, 0	0, 4, 0	0, 8, 0	0, 4, 0	0, 4, 0
VESA, PCI, proprietary slots	2, 0, 0	None	None	None	1, 0, 0	2, 0, 0
Parallel, serial, mouse ports on motherboard	1, 2, 0	1, 2, 1	1, 1, 1	1, 2, 1	1, 2, 1	1, 2, 1
Integrated network adapter option	None	None	Ethernet	None	None	None
Video						
Display circuitry location	VL-Bus card	Motherboard local bus	Motherboard local bus	VL-Bus	VL-Bus	VL-Bus card
Video chip set manufacturer	ATI	Cirrus Logic	S3	Cirrus Logic	S3	Cirrus Logic
Miscellaneous						
DOS 6.0/Microsoft Windows 3.1 included	■■	■■	■■	■■	□□	■■
Warranty	1 year	3 years	3 years	1 year	1 year	3 years
On-site service charge	Included (1 year)	Included (1 year)	Included (1 year)	N/A	Included (1 year)	Included (3 years)
FCC Class B identification number	HWYMICR486LB	HCJVECTRA486-XXVL	P94VECTRA486-33XM	AN02168-05	AN06384	CTD3333T

N/A—Not applicable The product does not have this feature ALR—Advanced Logic Research Inc., AMI—American Megatrends Inc., ATI—ATI Technologies Inc., C&T—Chips & Technologies Inc., SIS—Silicon Integrated Systems Corp., TI—Texas Instruments Inc., UMC—United Microelectronics Corp., VLSI—VLSI Technology Inc., WD—Western Digital Corp

				ENDS
NCR System 3350	**Northgate Superb**	**Northgate 486VL**	**Northgate ZXP EISA VESA**	**ZEOS 486DX2-66 Upgradable**
$4,300 (estimated)	$2,499	$2,899	$3,449	$2,995
Intel 486DX2/66	Intel 486DX2/66	Intel 486DX2/66	Intel 486DX2/66	Intel 486DX2/66
340MB	245MB	245MB	245MB	540MB
■■	■■	■■	■■	□■
Small-footprint	Desktop	Desktop	Desktop	Desktop
MCA	ISA	ISA	EISA	ISA
182W (4)	370W (3)	200W (5)	200W (5)	200W (7)
NCR	Northgate	Northgate	Northgate	ZEOS
NCR	VIA Technologies	C&T, OPTi	SIS	VLSI
ZIF socket	Standard socket	ZIF socket	Standard socket	ZIF socket
NCR (2/23/93)	AMI (11/5/92)	AMI (6/6/92)	AMI (6/6/92)	Phoenix 0307
■	□	□	□	■
2MB–192MB	2MB–128MB	1MB–64MB	4MB–256MB	2MB–64MB
128K	256K	256K	256K	256K
Two-way set-associative	Direct-mapped	Direct-mapped	Four-way set-associative	Direct-mapped
Write-through	Write-back	Write-back	Write-back	Write-back
0, 2	3, 0	3, 2	3, 2	2, 2
0, 3	1, 0	None	None	3, 0
1.44MB	1.44MB	1.44MB	1.44MB	1.2MB, 1.44MB
120MB–1GB	120MB–250MB	170MB–1.3GB	170MB–1.3GB	107MB–1.1GB
Motherboard	ISA card	VL-Bus card	VL-Bus card	Motherboard
0, 0, 4	0, 6, 0	0, 7, 0	0, 0, 8	1, 5, 0
0, 0, 1	None	2, 0, 0	3, 0, 0	2, 0, 0
1, 2, 1	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0
None	None	None	None	None
Motherboard	ISA card	VL-Bus card	VL-Bus card	VL-Bus card
NCR	Cirrus Logic	S3	Weitek	Weitek
■■	■■	■■	■■	■■
3 years	1 year	1 year	1 year	1 year
Included (3 years)	$78 (1 year)	Included (1 year)	Included (1 year)	$49 (1 year)
C6P3350-25	IU7DL4865-FGH	GT6486XVB	GT6486EXVB	B4DMAR4864DT

tested 486DX/33-based systems.

The 4DX-33's mini-desktop case has only three drive bays (two accessible and one internal) and five 16-bit ISA card slots. The system's 64K RAM cache can be expanded to 256K for an additional $60, and RAM can be increased to 64MB. But the 4DX-33's lack of local-bus support and limited number of drive bays suggests that this system is really a low-end configuration. Though the 4DX-33 motherboard has an Intel OverDrive socket, a single fan and tight internal space may not be adequate for cooling a Pentium processor.

4DX-33

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	POOR
Expandability	FAIR

4DX-33V

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	FAIR
Expandability	FAIR

For most users the full-size-case Gateway model is the better value. The $2,363 4DX-33V test configuration had the same add-in components as the 4DX-33 but had a local-bus video system. The 4DX-33V's five drive bays (three accessible, two internal) and seven 16-bit ISA slots (two double as VESA local-bus extensions) allow for more component expansion than the mini-desktop system does. System RAM and RAM cache in the 4DX-33V are limited to the same 64MB and 256K sizes, respectively, as the smaller case line.

CPUs available in Gateway's "V" line include 486SX/33, 486DX2/50, and 486DX2/66 chips. The tested 4DX-33V came with a local-bus ATI Ultra Pro video card based on ATI's Mach 32 Windows video accelerator chip. The ATI board—which is faster than the 4DX-33's integrated video—helped the 4DX-33V score in the middle of the 33-MHz CPU pack on the Graphics WinMark test.

The Gateway full-size-case series is appropriate if you want a moderately high-performance, single-user machine. A tower-case option is available for $100 and an EISA-bus model better suited to the greater throughput demands of network file servers, but the full-size desktop local-bus system is the best value.—*BB*

Hewlett-Packard Co.

HP Vectra 486/33VL
HP Vectra 486/33XM

Hewlett-Packard Co. has long been a quiet name in the PC market—always there and well thought of, but never creating any splash. Well, look out, because HP is getting serious and revamping its lines, with something in store for just about every type of computer user.

HP has just introduced four new lines, though they all carry the familiar Vectra name. At the bottom of the price list will be the HP Vectra 486/33VL, a line of desktop systems with proprietary local-bus graphics aimed at task-dedicated corporate users. Next up in HP's hierarchy, and competing for the midrange, will be the HP Vectra/N and the HP Vectra/M systems. These PCs are both local-bus machines that are easily upgradable to high-end video. Both are Pentium-upgradable, and the Vectra/M will have a built-in PCMCIA port available so that notebook peripherals can be used on the desktop. There will also be HP Vectra/Ni and HP Vectra/Mi models with 10BaseT connections integrated onto the motherboard.

At the high end will be the HP Vectra 486/33XM. This local-bus machine carries onboard Ethernet connections and has an infrared file-transfer link to HP's OmniBook 300 subnotebook PC; infrared-link modules for HP LaserJet printers are also available through third-party vendors. The 486SX/33 member of the Vectra XM family also complies with the EPA's Energy Star program guidelines for reduced energy usage. HP's plans include a separate Pentium line, the Vectra XP series, in November. The company will continue to sell solely through resellers, which will likely result in slightly higher price tags than its competition's.

For this review, Hewlett-Packard sent us the 486/33VL as a representative of its value-line offering and the 486/33XM for the high-end family. Though more than $1,500 separates these comparably equipped systems, both arrived in nearly identical lightweight plastic cases. They are built around vastly different motherboards and components. For example, the VL motherboard carries only 128K of external cache and a maximum of 32MB of RAM. Its local-bus video is based around a Cirrus Logic chip set and is accompanied by 1MB of VRAM. In contrast, the XM model can hold 64MB of RAM and 256K of external cache, and its local bus comes with 2MB of VRAM.

HP also sent us its desktop PCMCIA reader card in the XM. Sold through HP for $250, this option allows the system to use two Type II or one Type III PCMCIA card. The reader is compatible with the PCMCIA standard, but so far HP is only guaranteeing it to work with PCMCIA cards bought through HP. This reader is also available in the Vectra VL and M series machines.

Though the XM system we tested is claimed to be able to power down to less than 30 watts (the SX/33 XM normally operates at less than 30 watts), in compliance with the EPA's Energy Star program standards, the monitor we tested with both these machines could not. HP says that by this fall there will also be a high-end 21-inch monitor available that will comply with the EPA standards.

Performance for both the VL and the XM was average or slightly above average. Both machines were equipped with 486DX/33 processors and placed highly in that group. They were also competitive on our disk, memory, and video tests. The XM, however, outstripped the VL on the Windows graphics test, because of its S3 accelerator chip and more VRAM.

All Hewlett-Packard products ship with a three-year parts-and-labor warranty, with one year of free on-site service.—*OR*

Hewlett-Packard

VENDOR SERVICE & RELIABILITY	
Reliability	AVERAGE
Repair service	AVERAGE
Technical support	AVERAGE

Vectra 486/33VL

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	FAIR
Expandability	POOR

Vectra 486/33XM

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	FAIR
Expandability	FAIR

FACT FILE

HP Vectra 486/33VL

List price (tested configuration): $2,856
Memory and processor RAM cache: 8MB 70-ns SIMMs, 128K external cache.
Disk drives and controller: Quantum ProDrive LPS 240AT 16-ms 244MB IDE hard disk with 256K cache, integrated disk controller, 1.44MB floppy disk drive
Display: Integrated video controller with 1MB VRAM, Hewlett-Packard Super VGA D1194A 14-inch monitor with a 70-Hz refresh rate at 800-by-600
Software: DOS 6.0, Microsoft Windows 3.1

HP Vectra 486/33XM

List price (tested configuration): $3,676
Memory and processor RAM cache: 8MB 80-ns SIMMs, 256K external cache
Disk drives and controller: Same as 486/33VL
Display: Same as 486/33VL, but with 2MB VRAM
Software: DOS 6.0, Microsoft Windows 3.1
In short: With four new Vectra lines and numerous options, HP offers solid value and a variety of choices

Hewlett-Packard Co., 3000 Hanover, Palo Alto, CA 94086; 800-752-0900; fax, 800-333-1917.

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- **complete compatibility** — we're dedicated to building open systems ... systems that work with your networks and peripherals
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- Intel486SX/25 (upgradable to 50MHz)
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- 4MB RAM (70ns)
- 8KB Cache (max. Write-back 256KB)
- 3.5" Flex Drive
- 14" SVGA VESA Flicker-Free Econo-Monitor
- VESA Local Bus Video
- Windows TurboCharger w/1MB VRAM
- Pre-loaded Productivity Pak & 101-Keyboard
- 3-year on-site warranty
- 3 slots/3 bays

NCR 486DX/33

$ 1,745
or
$ 1,995 (w/240MB HD & 8MB RAM)

- ***Intel Pentium OverDrive Ready***
- Intel486DX/33 (upgradable to 66MHz)
- 160MB 17ms Hard Drive (max. 1GB)
- 4MB RAM (70ns)
- 8KB Cache (max. Write-back 256KB)
- 3.5" Flex Drive
- 14" SVGA VESA Flicker-Free Econo-Monitor
- VESA Local Bus Video
- Windows TurboCharger w/1MB VRAM
- Pre-loaded Productivity Pak & 101-Keyboard
- 3-year on-site warranty
- 3 slots/3 bays

NCR 486DX2/50

$ 2,255
or
$ 81.00/ month

- ***Intel Pentium OverDrive Ready***
- Intel486DX2/50
- 240MB 17ms Hard Drive (max. 1GB)
- 8MB RAM (70ns)
- 8KB Cache (max. Write-back 256KB)
- 3.5" Flex Drive
- 14" SVGA VESA Flicker-Free Monitor
- VESA Local Bus Video
- Windows TurboCharger w/ 1MB VRAM
- Pre-loaded Productivity Pak & 101-Keyboard
- 3-year on-site warranty
- 3 slots/3 bays

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- 14" SVGA VESA Flicker-Free Monitor
- VESA Local Bus Video
- Windows TurboCharger w/1MB VRAM
- Pre-loaded Productivity Pak & 101-Keyboard
- 3-year on-site warranty
- 3 slots/3 bays

NCR 486DX2/66

$ 3,155
or
$ 107.00/ month

- ***Intel Pentium OverDrive Ready***
- Intel486DX2/66
- 340MB 13ms Hard Drive (max. 2GB)
- 16MB RAM/256KB Write-back Cache
- 3.5" Flex Drive
- 14" SVGA VESA Flicker-Free Monitor
- VESA Local Bus Video
- Windows TurboCharger w/1MB VRAM
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Terrific for High Intensity Graphics!

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- 600MB CD ROM
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- 14" VESA SVGA Flicker-Free Econo-Monitor
- Super VGA Graphics Adapter
- Pre-loaded Productivity Pak & 101-Keyboard
- 3-year on-site warranty
- 6 slots/5 bays

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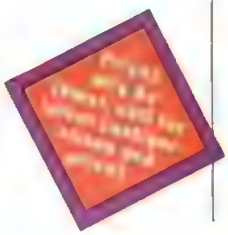

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- Snap-on cableless TrackBall
- Enhanced pre-loaded software: DOS 6.0, Windows 3.1, Bitfax, TourGuide, AT&T Mail, AccessPLUS and on-line Windows documentation
- 3-year Warranty (first year on-site)

3150 Mono Notebook

$2,195
or
$79.00/ month

- Intel486SX/25 (487 upgradable)
- 170MB Removable Hard Drive/Internal Flex Drive
- Mono Screen (9.5" diag.)
- Local Bus Video
- Simultaneous LCD/CRT display
- 4MB RAM/512KB Video Memory
- 1 PCMCIA slot (Type 2)
- 5.5 lb. Compact Unit/Featherweight 8 oz. AC adapter
- 3-4 Hour battery-life (NiCAD)
- Snap-on cableless TrackBall
- Enhanced pre-loaded software: DOS 6.0, Windows 3.1, Bitfax, TourGuide, AT&T Mail, AccessPLUS and on-line Windows documentation
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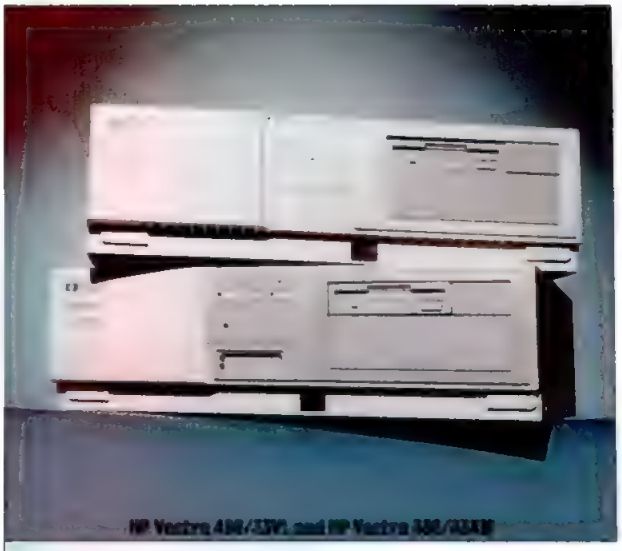

IBM Personal Computer Co.

IBM ValuePoint
IBM PS/1 486DX2/66

As IBM continues to explore today's ultra-competitive PC market, its product lineup comes into a clearer focus. IBM's PC lines start with two roughly parallel lines in terms of performance and features: PS/1 and ValuePoint. At the top is IBM's premier PS/2 family.

The aging PS/2 systems, based on the Micro Channel architecture, are being revamped. In the meantime, the energy-efficient PS/2 E is revealing a taste of what is to come (see "The Green Machine" in our issue of May 25, 1993). The IBM PS/2 will continue to appeal to buyers interested in high-end attributes—such as high-throughput Micro Channel architecture and data security—and to those with many PS/2s already installed. The company's ISA-based ValuePoint and PS/1, which use different motherboards and are aimed at different buyers, are fresh and up-to-date.

IBM

VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE

The PS/1 line is targeted to small- or home-business users. The systems are sold through different outlets, typically to nontechnical users. The focus is the mass retail channel (Staples, CompUSA), and systems come with exceptionally helpful and professional manuals and software. IBM plays a name game, with each PS/1 receiving a suffix indicating where it is available. Consultant (general merchandisers), Expert (computer stores), and Essential (office superstores) are the current monikers, with new Advisor (mass merchandisers) and Investor (warehouse or membership clubs) lines in the works.

Although the PS/1 we tested came in a mini-tower, IBM does sell a desktop version. The mini-tower has six drive bays, a 200-watt power supply, and eight ISA slots. The ISA slots are on a vertical backplane that plugs into its own slot on the motherboard.

Big Blue's ValuePoint line is aimed at price-conscious corporate buyers, but configurations and prices overlap with PS/1 systems. These PCs are available through IBM's sales force, resellers, and IBM PC Direct, the company's catalogue. They generally come with less software than the PS/1, but do have VESA local-bus graphics and 1MB of video DRAM. The ValuePoint's manuals demonstrate its corporate focus: Users get an "Intro to Computers" course, and administrators receive support information.

Our ValuePoint arrived in a small-footprint case with three front-accessible drive bays and a 145-watt power supply. You can upgrade only memory freely; the ZIF (zero-insertion-force) processor socket and upgradable external cache are awkwardly located under the drive bay assembly. Expansion is limited to four ISA-bus slots and one ISA VL-Bus slot, also mounted on a vertical backplane. The IBM 15-inch monitor had ample image controls, including adjustments for pincushioning and barrel distortion; on the other hand, colors often appeared faded.

FACT FILE

IBM ValuePoint

Estimated price (tested configuration): $3,109
Memory and processor RAM cache: 8MB 70-ns SIMMs, 128K external cache
Disk drives and controller: Western Digital Caviar 2340 14-ms 340MB IDE hard disk with 128K cache, integrated disk controller, 1.44MB floppy disk drive
Display: Integrated video controller with 1MB DRAM, IBM 6319 15-inch monitor with a 72-Hz refresh rate at 1,024-by-768
Software: DOS 6.0, Microsoft Windows 3.1

IBM PS/1 486DX2/66

Estimated price (tested configuration): $2,500
Memory and processor RAM cache: 8MB 70-ns SIMMs, 128K external cache
Disk drives and controller: Western Digital Caviar 2250 13-ms 255MB IDE hard disk with 64K cache, integrated disk controller, 1.2MB and 1.44MB floppy disks
Display: Integrated video controller with 1MB DRAM, IBM PS/1 Hi Function MS 14-inch monitor with a 70-Hz refresh rate at 1,024-by-768
Software: DOS 6.0, Microsoft Windows 3.1, America Online, Microsoft Works, Prodigy, one bonus program
In short: Both IBM units managed competitive performance scores on PC Labs' tests and offer good options for home, small-business, or corporate users

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Workgroups	Token Ring (4/16 Mbps)
Windows NT	*802.3
	Token Ring (4/16 Mbps)
IBM LAN Server	*802.3
	Token Ring (4/16 Mbps)
AppleTalk	*LocalTalk
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Solaris**	*Ethernet
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*Standard in the HP LaserJet 4Si MX printer. **For operating HP-UX, SunOS or Solaris, a one-time purchase of $199 in configuration software is required. Adobe and PostScript are trademarks of Adobe Systems Inc. which may be registered in certain jurisdictions. Microsoft is a U.S. registered trademark of Microsoft Corporation. UNIX is a registered trademark of UNIX System Laboratories Inc. in the U.S.A. and other countries. †In Canada call 1-800-387-3867, Ext. 7299. © 1993 Hewlett-Packard PE12353

Multiple environments are no longer worlds apart. Even if you have Novell Netware on one network, HP-UX on another and EtherTalk on a third, the new HP LaserJet 4Si MX printer easily connects across platforms. Automatically.

The HP LaserJet 4Si MX printer comes out-of-the-box preconfigured for multiple environments. There's nothing more to do than plug-and-play. All interfaces are simultaneously hot, making switching so seamless, end-users won't even notice.

What's more, HP's LaserJet 4Si MX printer is ready to handle whatever needs come down the

that adapts to multiple environments.

pike. More operating systems? No problem. As your network system continues to evolve, the capabilities of this printer are no longer just impressive. They're indispensable.

The HP LaserJet 4Si MX printer is loaded with features that define state-of-the-art. HP's enhanced PCL5 and genuine PostScript™ Level 2 software from Adobe™ come standard. Printer environments are saved while switching. Setup is a cinch with network software utilities and drivers included in the box. And, if you need any reassurance about trouble-free operation, you have it in our Simple Network Management Protocol (SNMP) support.

At 17 ppm, this is the fastest LaserJet ever, with I/Os and RISC-based formatter capabilities matched to support its speed. It delivers impeccable 600 dpi print quality—thanks to HP's microfine toner and Resolution Enhancement technology. Plus, it comes standard with two 500 sheet input trays.

But what if you don't need the full capabilities of the HP LaserJet 4Si MX printer right away? HP offers another printer that's probably a perfect fit. The HP LaserJet 4Si printer delivers the identical 17 ppm performance and superb 600 dpi print quality. It also has room to grow. The two MIO expansion slots let you add HP JetDirect network interface or third party cards. And you can add on Adobe's genuine PostScript Level 2 software and SIMM memory modules, as you need them.

To find out more about the multiple-network HP LaserJet 4Si MX printer and the upgradable HP LaserJet 4Si printer just call 1-800-LASERJET, Ext. 7299.† Capabilities this advanced make a world of difference—in any environment.

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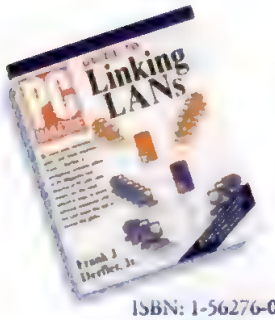
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PS/1 486DX2/66

SUITABILITY TO TASK	
DOS applications	EXCELLENT
Windows applications	FAIR
Expandability	FAIR

ValuePoint

SUITABILITY TO TASK	
DOS applications	EXCELLENT
Windows applications	GOOD
Expandability	FAIR

Both families use Intel processors exclusively, and our test systems came with DX2/66 CPUs. Each of them managed competitive showings within that group, except for the ValuePoint's second-place showing on our DOS-based disk test and third on the Windows disk tests—quite impressive given the competition.

The irony of IBM's multiple lines is that its ValuePoint PC is priced about $500 higher than a comparably equipped PS/1. The extra money buys you high-quality local-bus graphics. IBM will soon add a new family, called Ambra, that will be aimed at entry-level buyers. —*OR*

NCR Corp.

NCR System 3333
NCR System 3350

NCR Corp. sells a wide variety of desktop and floor-standing PCs ranging from low-end terminals to multiprocessor file servers. This variety is not helped by NCR's confusing model numbers that make it hard to differentiate systems. The result for the PC buyer can be confusion. All NCR customers work with VARs, dealers, or NCR direct-sales people who can guide them through the maze. NCR is considering establishing a direct channel.

NCR's new local-bus ISA 3230 entry-level family includes network terminals and low-end PCs. The tested units, both 486DX2/66-based, have different motherboards. They are the NCR System 3333, a local-bus mini-tower unit, and the NCR System 3350, an MCA workstation.

The NCR System 3230 was not available in time for testing. It will be available for $1,215 with a 486SX/25 CPU, 4MB of RAM (expandable to 64MB), three ISA slots, three drive bays, a 3.5-inch floppy disk drive, a 120MB hard disk, an integrated video controller with 1MB of VRAM, DOS, Windows, a keyboard, and a mouse.

NCR

VENDOR SERVICE & RELIABILITY	
Reliability	AVERAGE
Repair service	AVERAGE
Technical support	AVERAGE

System 3333

SUITABILITY TO TASK	
DOS applications	EXCELLENT
Windows applications	EXCELLENT
Expandability	EXCELLENT

System 3350

SUITABILITY TO TASK	
DOS applications	EXCELLENT
Windows applications	FAIR
Expandability	FAIR

The NCR System 3333 has six drive bays (four accessible) and six ISA slots, two with VESA local-bus extensions. RAM can be expanded to 64MB. The System 3333's motherboard has integrated I/O and drive controllers but requires a video card. NCR sells a variety of video cards with Cirrus Logic, S3, and Weitek video chips. The unit came with a 66-MHz DX2 CPU, 8MB of RAM, a 64K cache, a 340MB hard disk, a 3.5-inch floppy drive, a Cirrus Logic video board, a 15-inch NCR monitor, DOS, Windows, and a mouse. This model performed well

NCR System 3333 and NCR System 3350

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Subnote's full-size, full-travel 79-key keyboard has inverted-T cursor control, editing and function keys, a numeric keypad, and a built-in trackball with side panel buttons. You don't get cramps lifting it; you don't get cramps using it.

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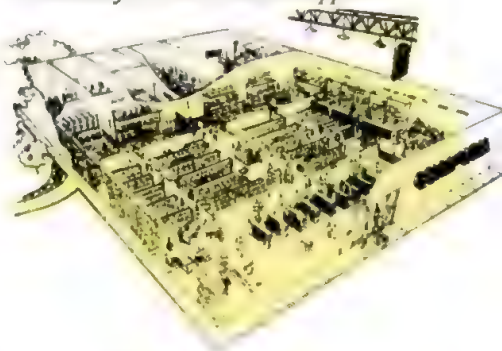

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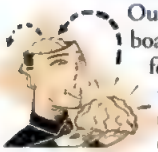

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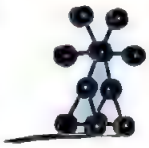

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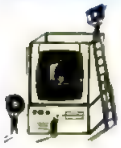

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FACT FILE

NCR System 3333

Estimated price (tested configuration): $2,995

Memory and processor RAM cache: 8MB 70-ns SIMMs, 64K external cache

Disk drives and controller: Western Digital Caviar 2340 13-ms 340MB IDE hard disk with 64K cache, integrated disk controller, 1.44MB floppy disk drive

Display: Cirrus Workstation Graphics VESA local-bus controller with 1MB of DRAM, Lite-on/NCR 15-inch monitor with a 72-Hz refresh rate at 1,024-by-768

Software: DOS 6.0, Microsoft Windows 3.1.

NCR System 3350

Estimated price (tested configuration): $4,300.

Memory and processor RAM cache: 8MB 70-ns SIMMs, 128K external cache.

Disk drives and controller: Maxtor LXT340SY 15-ms 340MB SCSI hard disk with 128K cache, NCR 53C94 SCSI integrated disk controller, 1.44MB floppy disk drive

Display: Same as System 3333, except with integrated video controller with 1MB of DRAM

Software: DOS 6.0, Microsoft Windows 3.1.

In short: From entry-level desktop PCs to powerful servers, NCR provides a wide variety of solid options

NCR Corp., 1700 S. Patterson Blvd., Dayton, OH 45479; 800-225-5627.

478 ON READER SERVICE CARD

on our benchmark tests, particularly in DOS video and DOS and Windows disk tests. The System 3333 is a flexible unit that can be configured either for power users or as a small server.

At the high end is the NCR System 3350, a small-footprint MCA-bus unit with five drive bays (two for removable media devices), four MCA expansion slots, and one proprietary expansion slot. Maximum RAM capacity is 192MB with 32MB SIMMs in each of six sockets. The buyer can choose either 128K or 256K of external RAM cache. The tested System 3350 sells for $4,300 with 8MB of RAM, a 128K RAM cache, and a 340MB hard disk. Video is handled by the combination of a Western Digital chip set integrated on the motherboard and the same monitor used with the System 3333. With a 486DX2/66 CPU, the System 3350 was an average performer on our benchmark tests; its Windows video graphics score was very low because of the nonaccelerated video circuitry. The System 3350 has the advantage of the MCA bus but the disadvantage of a constrained layout. One big plus is its dual fans and modular processor card, which should accommodate a Pentium processor.

NCR sells via a direct international sales force, dealers, and a VAR network that includes groups that sell directly to financial, medical, and retail markets. Service and support, available through a 24-hour 800 number, is backed by a three-year parts-and-labor warranty with free on-site service for the same time period.—*BB*

PC FAMILY PROFILE

NEC Technologies Inc.

NEC Ready
NEC PowerMate
NEC Image

NEC Technologies offers three PC lines—Ready, PowerMate, and Image—that can't really be categorized as low-end, medium, and high-end. All will be revamped by this fall and thus were not ready for review in this roundup.

The Ready and PowerMate lines hover around the same price range but are targeted at different customers. The Ready series is aimed at home-office and small-business users, while the PowerMates are designed for large businesses.

The Ready units, sold through retail channels, are easy to set up. They come preloaded with business-level software and offer remote diagnostic services through fax modems integrated on their motherboards.

The PowerMates don't come with the Ready line's set of preloaded software or integrated fax modems. Rather, they are designed for moderately demanding office applications, and they are expandable. PowerMate configurations range from inexpensive network nodes to high-powered workstations.

The Image line, with units like the Pentium-powered Image P60, is clearly the high end of NEC's performance spectrum. The Image P60 offers a 64-bit memory interface, NEC's ImageVideo graphics subsystem on a PCI-standard local

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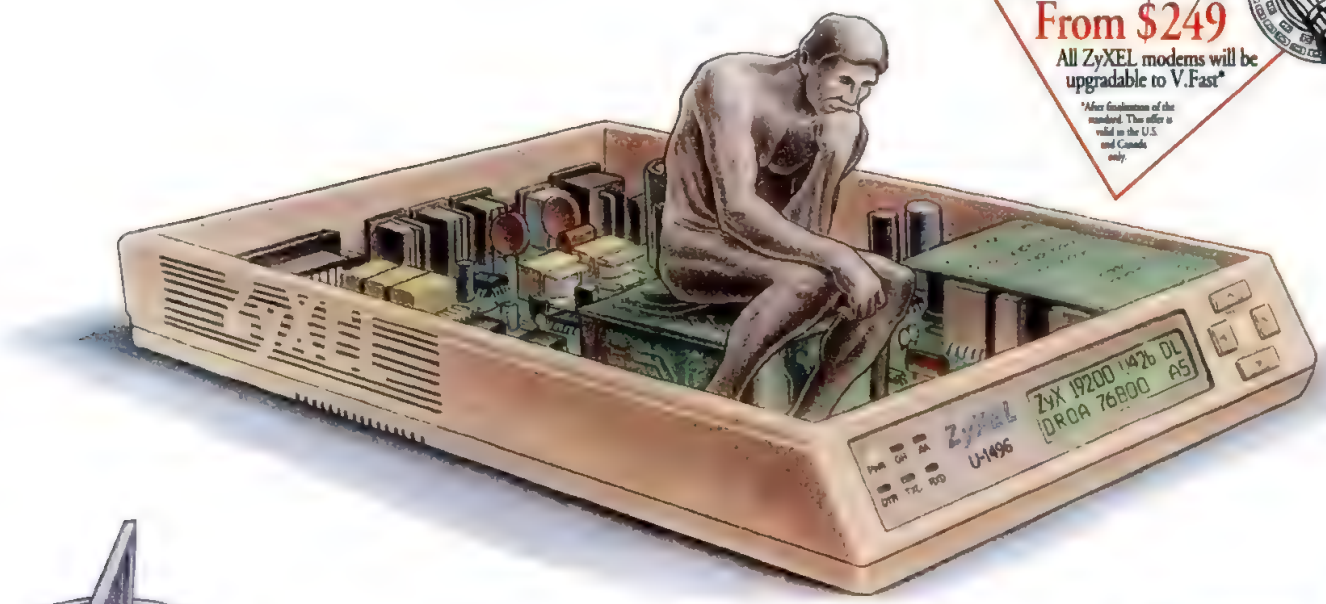

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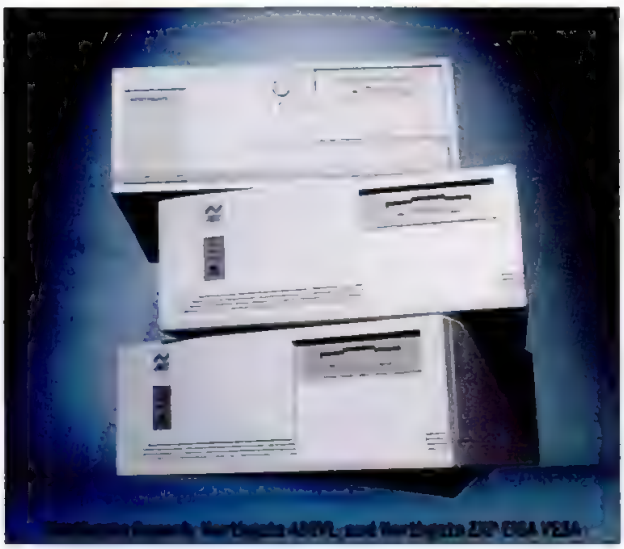
bus, and a 256K secondary cache that supports the Pentium chip's high-speed "burst" mode. The Image also offers hardware support for Windows audio functions.—*RSA*



Northgate Superb, Northgate 486VL, and Northgate ZXP EISA VESA

Northgate

Northgate Superb
Northgate 486VL
Northgate ZXP EISA VESA

Northgate sells seven separate lines of PCs, each with clear performance and expansion differences. In addition to the Superb line of non-local-bus ISA machines, the VL local-bus ISA series, and the ZXP EISA VESA line, Northgate has a line of file servers, a 386-based line, the Elegance line, and a line of PCs in slimline cases. For this review, we tested representatives of the mainstream Superb, 486VL, and ZXP EISA VESA lines.

All Northgate computers are sold by direct mail and telephone sales and come with a one-year parts-and-labor warranty and 24-hour toll-free technical support. In addition, all except the Superb line include free on-site service (Superb owners can buy a one-year on-site service contract for $78).

The entry-level Superb line is targeted for the home market and as a low-end network workstation. The line's baby-AT-style case has one internal and three accessible drive bays and six 16-bit ISA slots; however, a lack of motherboard integration limits expandability by tying up several slots. This ISA-bus system is available with 25-MHz and 33-MHz 486DX processors or a 486DX2/66. No RAM cache is standard, but 128K and 256K upgrades are available for $75 and $150, respectively; the company recommends this option for DX2/66 PCs.

The $2,499 test system came with a 66-MHz 486DX2 processor, 8MB of RAM, a 256K RAM cache, one 1.44MB floppy disk drive, a 245MB Quantum ProDrive IDE hard disk, and an STB video card based on a Cirrus Logic video chip. As did the other Northgates, the Superb model came with a Northgate SVGA-15 15-inch 1,024-by-768 monitor, limited to a below-VESA-specification 60-Hz refresh rate at its maximum resolution.

The Superb unit did well on our benchmark tests for an ISA machine, helped particularly by the 66-MHz CPU, big RAM cache, and fast-caching hard disk.

Intended for use by professionals, engineers, and power users because of its greater expandability and local bus, the Northgate 486VL line's case has five accessible drive bays. The case and its internal structure are also more highly finished than in the Superb unit. The local-bus motherboard has seven 16-bit ISA slots, two with VESA local-bus extensions. A 128K RAM cache is standard, with 256K and 512K a $60 or $210 option, respectively. The test unit came with an STB local-bus video board with an S3 video accelerator chip. Equipped like the Superb system otherwise, the 486VL unit sells for $2,889. The VL test unit had

Northgate

VENDOR SERVICE & RELIABILITY	
Reliability	AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE

Superb

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	FAIR
Expandability	FAIR

486VL

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	FAIR
Expandability	FAIR

ZXP EISA VESA

SUITABILITY TO TASK	
DOS applications	EXCELLENT
Windows applications	EXCELLENT
Expandability	GOOD

FACT FILE

Northgate Superb

List price (tested configuration): $2,499
Memory and processor RAM cache: 8MB 60-ns SIMMs, 256K external cache
Disk drives and controller: Same as 486VL, except with Northgate ISA card disk controller
Display: Same as 486VL, except with STB Horizon VGA ISA card controller with 1MB DRAM
Software: DOS 6.0, Microsoft Windows 3.1

Northgate 486VL

List price (tested configuration): $2,899
Memory and processor RAM cache: 8MB 70-ns SIMMs, 256K external cache
Disk drives and controller: Quantum ProDrive LPS 240AT 16-ms 245MB IDE hard disk with 256K cache, DTC 2270VL VESA local-bus card disk controller, 1.44MB floppy disk drive
Display: STB PowerGraph VL-24 VESA local-bus card controller with 1MB DRAM, Northgate SVGA-15 15-inch monitor with a 60-Hz refresh rate at 1,024-by-768
Software: DOS 6.0, Microsoft Windows 3.1

Northgate ZXP EISA VESA

List price (tested configuration): $3,449
Memory and processor RAM cache: 8MB 70-ns SIMMs, 256K external cache
Disk drives and controller: Same as 486VL
Display: Same as 486VL, except with Northgate Star2000 SVGA VESA local-bus card controller with 2MB VRAM
Software: DOS 6.0, Microsoft Windows 3.1
In short: Northgate's well-defined PC lines let you choose a motherboard and case based on your performance and expansion needs

Northgate, 7075 Flying Cloud Dr., Eden Prairie, MN 55434; 800-548-1996, 612-943-8181; fax, 612-643-6965.

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trouble keeping up with the other 66-MHz PCs in this test in DOS video, a deficiency we attribute to the S3 chip set.

The Northgate ZXP EISA VESA line, primarily intended as a midrange to high-end file server and for the most demanding power users, is ordinarily sold in a tower case. This series features five EISA slots and three VESA local-bus slots. The ZXP case had, like the VL unit, five accessible drive bays. A standard 256K RAM cache can be increased to 512K for $150. On-board RAM can be upgraded to 256MB.

The tested-configuration ZXP EISA VESA system—with a 66-MHz 486DX2 CPU, 8MB of RAM, a 256K cache, a 245MB hard disk, and a Weitek Power 9000-based video board with 2MB of VRAM—sells for $3,499. This system was easily the fastest of the tested Northgate machines and generally held its own against the other 66-MHz–based systems in this roundup. Its strength was Windows video, and its weakness was poor DOS video performance, a characteristic of the Weitek video chip.

These three Northgate PC lines present a clear hierarchy of performance and system expansion.—*BB*

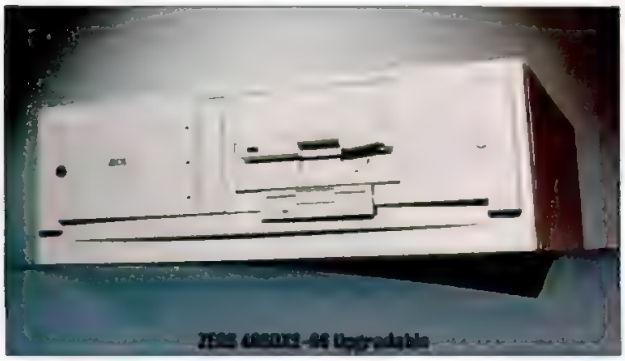
ZEOS International Ltd.

ZEOS 486DX2-66 Upgradable

ZEOS International sells one base-priced line of computers through the direct channel. The Minneapolis-based ZEOS tried selling a separate line called Occidental Computer Systems but discontinued marketing it, although they are still sold and supported. According to ZEOS, the greater costs of maintaining two distinct computer lines were not justified. Also, company representatives say, the current trend to separate value lines is a temporary phenomenon that may have short-term use to pacify channel conflicts as traditional dealer sales-oriented vendors switch to include mass merchandising and direct sales.

Having established company policy that its "value" line is its standard—and indeed only—line, ZEOS does sell a ZEOS LiteLine Ambra series of limited network nodes or very low-end PCs. The LiteLine Ambras, which we did not test, come in two configurations: with a 486SX 25-MHz or 33-MHz CPU, a 64K nonexpandable RAM cache, and 512K of video RAM for nonaccelerated video (a 1MB option is also available). These low-end units have five ISA slots and four drive bays. A LiteLine Ambra with 4MB of RAM, a 100MB hard disk, a 14-inch 1,024-by-768 monitor, two floppy disk drives, DOS, Windows, and a mouse sells for $1,495; a 486SX/25-based system is $100 less. Since a similarly configured regular ZEOS Upgradable sells for roughly the same price, it's clear that the true value in ZEOS computers lies in the company's regular systems.

The tested ZEOS 486DX2-66 Upgradable sells for $2,995 with 8MB of RAM, a 256K RAM cache, a local-bus drive controller, a 540MB hard disk, and a 14.4-bps fax modem. In addition, the unit includes a 1MB VRAM Diamond Computer Systems Viper VLB local-bus accelerator card (a $200 option) with a Weitek Power 9000 video chip and a 70 Hz 1,024-by-768 noninterlaced 15-inch monitor. The system showed slow performance in DOS video, but it was the top performer in Windows graphics and on the DOSMark and DOS disk tests. The ZEOS Upgradable holds its own even among the EISA systems in its comparison group of DX2/66-based machines.


ZEOS 486DX2-66 Upgradable

ZEOS's motherboard can be expanded to 64MB of RAM. That makes it competitive with other vendors' low-end and middle-line systems, but not quite with several vendors' high-end machines. The four accessible and three internal drive bays provide an ample storage capacity and variety for all but the highest end server applications, for which purpose ZEOS sells a tower chassis option with ten bays total.

There are six ISA slots on the ZEOS motherboard—one 8-bit and five 16-bit—and two local-bus slots. Combined with the on-board local-bus controller, the system is set up to handle the VESA VL bus's current maximum of three local-bus devices. The ZEOS's ZIF socket and dual cooling fans will support the Pentium OverDrive upgrade.

ZEOS 486DX2-66 Upgradable

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	EXCELLENT
Expandability	FAIR
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE

ZEOS sells computers only via direct telephone and mail-order sales. ZEOS International's service includes 24-hour, toll-free technical support and a one-year parts-and-labor warranty. On-site service is not standard but costs $49 for one year, with the service provided by Dow Jones.—*BB*

FACT FILE

ZEOS 486DX2-66 Upgradable

ZEOS International Ltd., 1301 Industrial Blvd., Minneapolis, MN 55413; 800-554-7172, 612-633-4591; fax, 612-633-1325.

List price (tested configuration): $2,995 (includes 14,400-bps data/fax modem)

Memory and processor RAM cache: 8MB 70-ns SIMMs, 256K external cache

Disk drives and controller: Seagate ST3600A 12-ms 540MB IDE hard disk with 256K cache, integrated disk controller, 1.2MB and 1.44MB floppy disk drives

Display: Diamond Viper VLB VESA local-bus card controller with 1MB VRAM, ZEOS Color SVGA 15-inch monitor with a 70-Hz refresh rate at 1,024-by-768

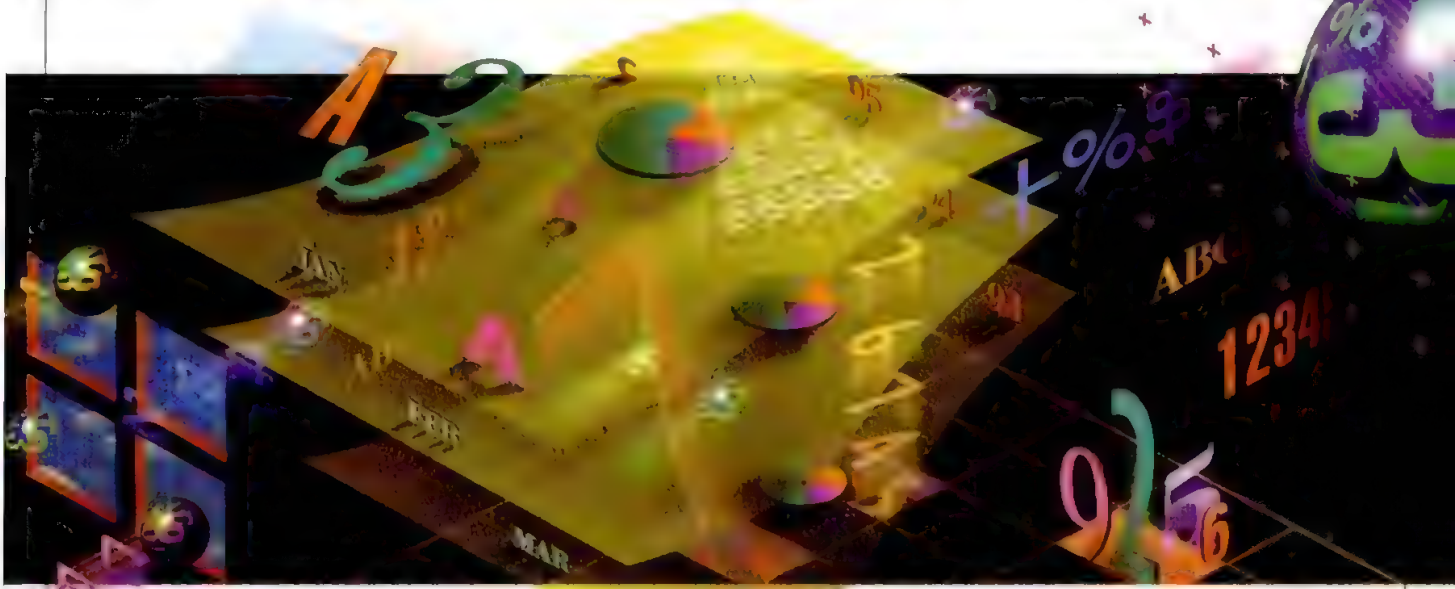
Software: DOS 6.0 with Enhanced Tools, Microsoft Windows 3.1, Lotus Organizer, choice of Lotus application software, QuickLink II

In short: ZEOS doesn't sell a separate value line, but the flexibility of its main system may be the least confusing solution of all

400 ON READER SERVICE CARD

ALTERNATIVE VIEWS

New Dimensions in Spreadsheets



As data becomes more complex, today's spreadsheet-like products rise to meet the challenge.

The market for spreadsheet software is vast, mature, and well consolidated. Three players dominate the field, turning out annual upgrades to their already massively rich, bargain-priced products. As the competition between Borland International, Lotus Development Corp., and Microsoft Corp. has taken on a leapfrog quality, with each company one-upping the others at every turn, the market-share slice called "Other" seems to get thinner by the year.

Zoom in for a closer look at Other, though. There's a veritable ant farm of activity going on there, right under the giants' feet, all of it aimed at exploiting chinks in the major spreadsheet products. In this review we survey some of that activity.

Spreadsheets are popular for lots of good reasons. They're easy to understand and learn, great for ad hoc analysis, and handy for managing simple databases; they

by Craig Stinson

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Lotus Improv for Windows 207

Illustration by Jesse James Doquilo

HIGHLIGHTS

Alternative Spreadsheets

YOUR NEXT STEP in terms of spreadsheets can be a hop or a leap, depending on the tool you choose.

JAVELIN WAS THERE FIRST, but it's taken the interest of the big boys to reignite its dimming fire.

IMPROV'S 1-2-3–LIKE familiarity will likely breed users, not contempt.

DS LAB DOESN'T WORRY about being familiar. It offers a new, diagrammatic approach to data modeling.

TM/1 PERSPECTIVES SOOTHES new users by joining with Microsoft Excel and Lotus 1-2-3 for Windows. The spreadsheet holds the data and TM/1 reshapes and shows the data in ways these users could once only imagine.

MICROSOFT AND BORLAND are preparing to build true multidimensionality into their latest spreadsheet upgrades.

have superb charting modules and come with rich programming languages; and on and on. Some of them even do slide shows.

The rap sheet is impressive, too. Here is a partial, unsorted list of reasons why your spreadsheet may not be the perfect modeling tool:

• Spreadsheet models rely on positional references. You would never build even the simplest BASIC program with statements like "add the last six variables I've declared, whatever they happen to be." Yet that's exactly the kind of formula that spreadsheet programs encourage you to write. Move a few cells and your model may be littered with broken logic.

• Spreadsheet models are difficult to document. The typical positional formula provides no clue to its meaning. You can assign names to cells, of course, and use names in place of positional references, but research indicates that few users do.

• In a spreadsheet model, inputs and processing are indistinguishable. A tidy model puts its inputs, assumptions, and formulas in separate places, each accompanied by notes and comments. But who writes tidy models?

• In a conventional spreadsheet, the model is the data. You're vulnerable even if you're tidy. Because the worksheet is the data structure, not just a report-mode image, if you break it you lose it.

• Three fixed dimensions (rows, columns, and pages) are not enough to model the real world.

• Spreadsheets are not very good at managing multiple levels of aggregation. Of the major products, only Microsoft Excel offers an outlining facility, letting you click buttons to move between, say, a five-year view, an annual view, and a quarterly view. Programs equipped to handle real-world complexity should let you do this as easily as turning the lens turret on a microscope.

MURDERERS' ROW

These shortcomings of spreadsheet programs have been recognized from VisiCalc's day on down. They have in fact been the stuff of software developers' dreams. In 1985 the computer press touted a program called Javelin as the next "killer app" (the previous one having been Lotus 1-2-3), because Javelin offered multidimensionality, sophisticated functions for aggregating data across time, nonpositional referencing, and an elegant user interface. But Javelin was not able to unseat Lotus 1-2-3, and people continued to buy spreadsheets.

That was more than half a decade ago. Will today's marketplace be more receptive to alternative modeling tools? It may. Two converging currents—the migration of traditional mini- and mainframe methods to the desktop, and the growing power of conventional spreadsheet programs—have led users to entrust ever larger and more critical apps to programs such as Lotus 1-2-3, Microsoft Excel, and Borland's Quattro Pro. Some frustration has arisen because those apps require a more robust modeling environment than the normal spreadsheet can provide.

Moreover, Lotus, the company that was Javelin's principal target in the 1980s, has now thrown its own considerable research and development and marketing muscle into the alternative-spreadsheet game. Shipment this year of Lotus Improv for Windows (along with Improv's introductory impulse-buy pricing) has stimulated renewed interest in unconventional approaches to modeling.

UNCONVENTIONAL DIMENSIONS

In the following pages, we offer reviews of five unconventional modeling programs, plus a preview of a sixth (CA-Compete!) that was still in beta testing when we went to press. Four of these programs—CA-Compete!, FreeThink, Javelin Plus, and Lotus Improv for Windows—fall into the hazy multidimensional-spreadsheet category. The remaining two, DS Lab and FuziCalc, attack the spreadsheet citadel from other flanks. We also look at an add-in product, TM/1 Perspectives, that lets you work more effectively with multidimensional data within the traditional spreadsheet context.

DS Group describes DS Lab as a spreadsheet without cells. With this product you build models diagrammatically, much as you might flowchart a program, by arranging symbols on a drawing screen. Each type of modeling element—single constants, arrays of constants, lookup tables, and "scripts"—is represented by a standard symbol, and arrows between symbols indicate the flow of dependency.

FEATURES PLUS

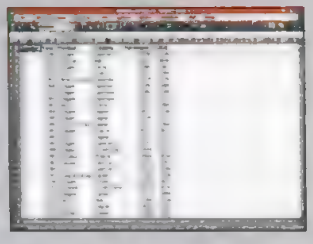
You can download some of these demos from ZiffNet. Type GO EXEC at any ZiffNet or CompuServe prompt and look for them in Library 15, Demos Showcase.

Our Contributors: CRAIG STINSON is a contributing editor to *PC Magazine*. TED STEVENSON was the associate editor in charge of this story, and BEN Z. GOTTESMAN was the project leader.

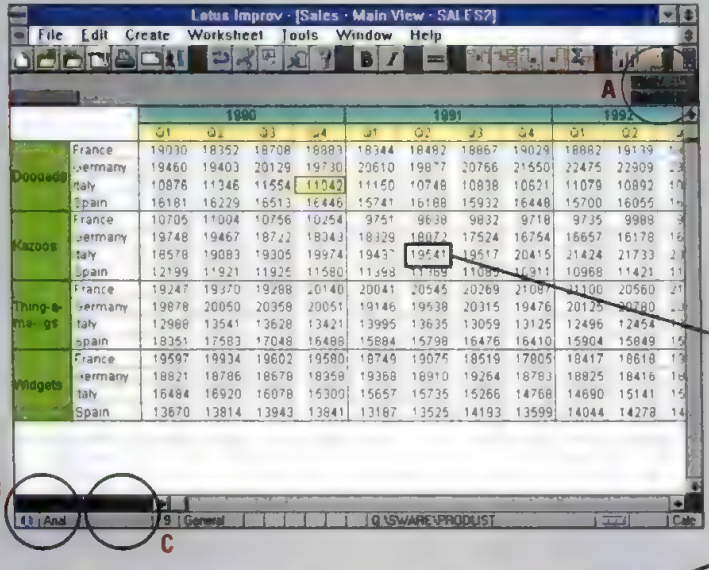
MODELING MULTIPLE DATA DIMENSIONS

A Few Steps Through the Looking Glass

Databases typically show data in a tabular form, whether the data resides in a product like dBASE or Paradox, or a spreadsheet like Microsoft Excel (pictured at right) or Lotus 1-2-3. Gathering dynamic information from such a view can be difficult. In a typical database report, columns may be sorted and summarized in a variety of ways, but it's hard to extract the kernel of information without "aggregating," "consolidating," and summarizing it along a variety of data axes. For example, how easily can you group sales by quarter to reveal a seasonal pattern? Can you use a product-by-country dimension to reveal whether France's widget-import total shows consistent growth, which can be used to forecast future sales?

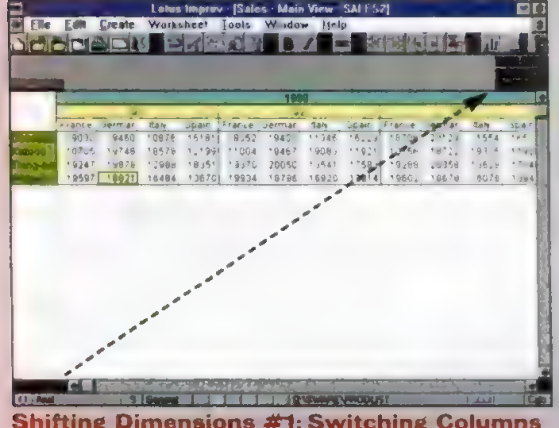


Multidimensional Spreadsheet: The Initial View In the multidimensional spreadsheet, database fields can become categories. The user can choose how to present the data—which dimensions appear as rows, or columns, and what will be summarized and how. For our example, we have grouped Products and Countries in the rows. Years and Quarters are placed in the columns.

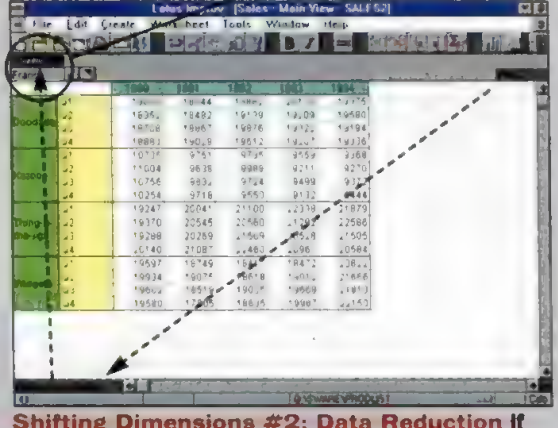


Dimensions consists of groups of similar data, such as (A) time values (Year and Quarter), (B) things (Product), and (C) places (Country). The circled cell shows the number of kazoos sold in Italy during the second quarter of 1991.

Placing a dimension in this area lets you "page through" each item within the dimension.



Shifting Dimensions #1: Switching Columns and Rows To see how each country performed in each quarter for each year, drag the Country box (in the lower-left-hand corner) to the upper-right-hand corner and place it directly below Quarter. The data is automatically reordered to reflect the change.



Shifting Dimensions #2: Data Reduction If having too many categories presents more numbers than you can clearly understand at one time, move the Country category to the page area and view each year's quarterly product sales one country at a time. Click on the arrows by the country name to change the country being viewed.

Sinper Corp.'s TM/1 Perspectives

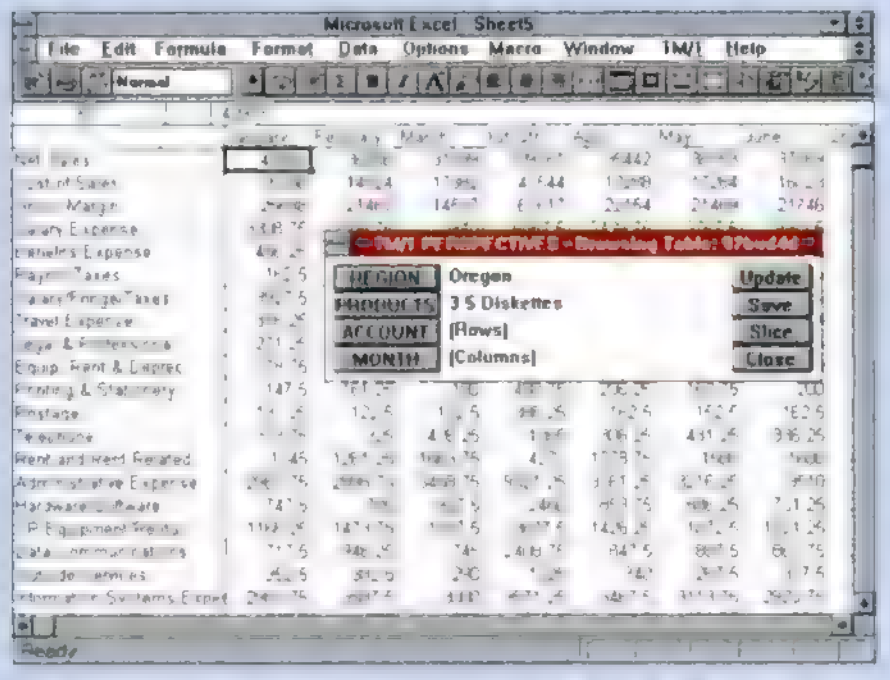
by Craig Stinson

Unlike other companies included in this article, Sinper Corp. doesn't claim that its TM/1 Perspectives is a powerful modeling engine. It assumes that for testing hypotheses, measuring relationships, and evaluating scenarios, your conventional spreadsheet program is sufficient. What Sinper wants to sell you is a tool for building and managing large, multidimensional data structures that you can display, analyze, chart, and print with your spreadsheet.

TM/1 Perspectives is significantly more advanced than its standalone character-mode forebear, TM/1. It uses the standard Microsoft Windows interface, and it grafts itself onto the analytic horsepower of Microsoft Excel and Lotus 1-2-3.

TM/1 Perspectives is particularly convenient because it performs these services as an add-on operating within the context of familiar Windows spreadsheet programs (currently Microsoft Excel for Windows 4.0, and Lotus 1-2-3 for Windows 1.1). You can build, edit, browse, and pivot tables by choosing add-in commands located on your spreadsheet's own menu bar. When you want to do further analytical work with a data slice, you can use another add-in command to plant the numbers on a standard Excel or Lotus 1-2-3 worksheet.

This approach is similar to that of CA-Compete!, which also exports rows and columns from its slicer-dicer to its own conventional spreadsheet module. But where CA-Compete! sends calculated constants to the worksheet, TM/1 Perspectives supplies live formulas, built with the program's custom add-in functions. Meanwhile, the underlying data structure remains on the disk or server. The worksheet view automatically reflects the database changes. To capture the view, you perform a copy and paste-special to plant current values on another worksheet.



TM/1 Perspectives lets users take complex data in Microsoft Excel 4.0 and model it without removing it from the original spreadsheet.

TWO FLAVORS

TM/1 Perspectives comes in two sizes, both of which can create tables of up to eight dimensions. The Corporate version supports as many elements per table as your spreadsheet has rows, while the Professional version is limited to 128 elements per table.

Tables are built from two separate files; one records the dimension structure and the other holds data. This strategy makes it easy to reuse dimensions in multiple contexts. For example, if you have several models for which monthly figures are summed into quarterly totals, you can set up the time dimension once and incorporate it into each model. You can build tables and dimensions from scratch on worksheet-like grids, or you can import comma-separated values.

Either version provides as many nested aggregation levels as you please. Regions may consolidate states, which may consolidate stores, and so on. The aggregation formulas, however, are limited to addition, subtraction, and averaging. □

▶ FACT FILE

TM/1 Perspectives, Release 1.0
Sinper Corp., 31 Mountain Blvd., Warren, NJ 07059; 800-822-1596.
List price: *Professional version, $195 (until December 31); Corporate version, $495 (until December 31).*
Requires: *4MB RAM; 1MB hard disk space; Microsoft Windows 3.1 or later (in Enhanced mode); Microsoft Excel for Windows 4.0, or Lotus 1-2-3 for Windows 1.1.*
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FuziCalc attempts to solve a different problem: the fact that models are usually founded on uncertain premises. With FuziCalc you express the range of possibilities for each "fuzzy" input in the form of a "belief graph," and the program gives you back a belief graph for each of the model's outputs.

DIMENSIONS OF MULTIDIMENSIONALITY

Multidimensional tools have two things in common. They are adept at swapping categories between row, column, and page axes so that you can see a common base of information from many different vantage points (see the sidebar "Modeling Multiple Data Dimensions: A Few Steps Through the Looking Glass"). And they either require or strongly encourage formula generality. With a multidimensional spreadsheet such as CA-Compete!, for example, you will almost always express the cost of goods sold as the sum of various named factors (such as Materials.Cost+Production.Cost), not with references to worksheet coordinates. Beyond these two principles lie many differences in style and substance.

Those used to spreadsheets may feel most at home in Improv or CA-Compete!. Both programs look and feel like the old familiar thing. Models are built on the grid, and referencing variables in formulas is typically as simple as pointing to row and column headings. Both programs include basic charting services, as

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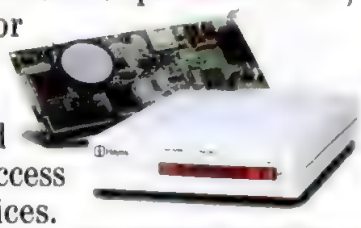

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IBM

well as strong links with their vendors' conventional spreadsheets (CA-SuperCalc and Lotus 1-2-3, respectively). Improv offers the additional benefit of bidirectional hot-linking with Lotus Notes.

FreeThink and Javelin, on the other hand, treat the worksheet primarily as a reporting vehicle. Variables are named, and relationships are, for the most part, defined elsewhere. Both are character-mode programs, and neither offers the easy drag/drop transposability of the Improv or CA-Compete! worksheet. On the other hand, because the worksheet is a window onto a separate data structure, it's nearly impossible to destroy a Javelin or FreeThink model with an errant worksheet deletion.

Javelin's particular strength is its convenient and intelligent handling of time-series data. The program knows the calendar and offers a myriad of useful, easy-to-apply options for converting numbers between different time periodicities. FreeThink, on the other hand, is the only program in this set that can easily structure data into an unlimited number of nested aggregation levels.

Sinper Corp.'s TM/1 Perspectives builds and manipulates large multidimensional tables. This add-in for Excel and Lotus 1-2-3 for Windows offers no modeling logic beyond the ability to perform sums and averages, but you can use it to fetch and transpose multidimensional data, and then convert slices to live worksheets for analysis by the host spreadsheet.

GETTING INTO THE ACT

TM/1 Perspectives makes the assumption that when it comes to analyzing your data, as opposed to structuring it or changing your viewing angle of it, conventional spreadsheets are still the tool of choice. Borland and Microsoft seem to have reached the same conclusion. In the next versions of Excel and Quattro Pro for Windows, you can expect to see clever, easily used cross-tabulation features that will let you transform flat tables of multidimensional information into meaningful, manipulable displays. (The current version of Excel already has a crosstab module, which the next version will improve and simplify.) The resulting tables will even look rather like Improv worksheets.

Three more multidimensional modelers arrived just after our review deadline: Lighten's Advance (510-284-1881), Comshare's Commander Prism (800-922-7979), and IntelligenceWare's Corporate Vision (310-216-6177). And the emergence of a powerful breed of client-server products can potentially change the modeling landscape even more dramatically.

One such product is Arbor Software Corp.'s Essbase, a 32-bit multithreaded system that can run under Microsoft Windows NT and OS/2. Essbase offers unlimited dimensions, unlimited aggregations within dimensions, and an exceptionally high degree of integration with Excel and Lotus 1-2-3. Prices begin at $27,000 for an unlimited number of users. *PC Magazine* might review products in this price range in a future review.

DS Group Inc.

DS Lab
DS Lab Pro

ALL REVIEWS
BY CRAIG STINSON

The row-and-column format used by conventional spreadsheet programs is fine for tabulating results but lousy for demonstrating modeling logic. That's the premise behind the DS Lab family, which the vendor touts as the "first spreadsheet without cells."

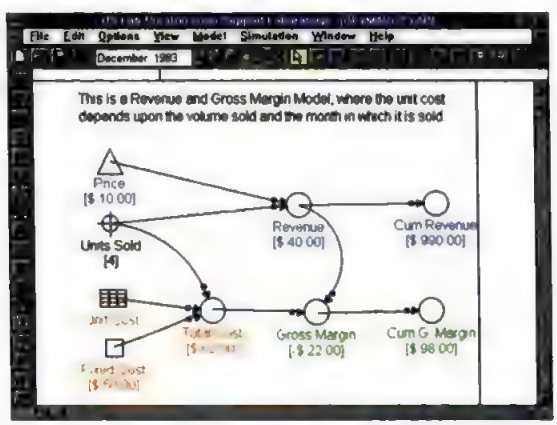
The $195 DS Lab, Version 2.0, supports up to 100 elements and 366 steps; its $995 big brother, DS Lab Pro, Version 2.0, supports models with up to 1,000 elements and 2,048 steps. (After October 1, prices will increase to $295 and $1,495, respectively.) With either package you build a model by planting symbols on a "drawing canvas" and connecting them with arrows. Each symbol represents one element of the model, and the arrows indicate the chain of dependencies.

Elements may be single constants, arrays of constants, or the results of calculations. Behind each element lies a value, a table of values, or a script. Constants may be entered directly or derived via a DDE link with other Microsoft Windows programs (your Windows database or conventional Windows spreadsheet, for example). A script can be anything from a simple formula to a sizable program built with the software's scripting language. To supply the values or formulas behind an element, you double-click on its symbol and fill out a dialog box.

Once you have drawn the elements and supplied the appropriate values and formulas, a single mouse click "runs" the model, turning inputs into outputs. Models may perform a single calculation or, more typically, a specified number of iterations. In a monthly cash-flow model, for example, you might run some multiple of 12 iterations. In this case, the software would record the outputs for each iteration, identifying each by month and year.

NEW VIEWS

After you have run a model, you can use a drop-down list at the top of the window to inspect the values associated with each iteration. Or, with another mouse click, you can generate a tabular report. The current versions of the programs (actually the first commercial releases) are on friendly terms with Microsoft Excel and can be set to send results automatically to an Excel spreadsheet.



Here's a simple DS Lab model with all the available element types, including What If (triangle) and Fixed Constant (square).

You can set up outbound DDE links with other programs, or simply copy results elsewhere via the Clipboard. You will most likely want to do some form of transfer, since the tabular reports are quite static. You can print them but you can't format or annotate them.

Borland's Data Modeling Desktop

by Craig Stinson

Borland International's response to Lotus Improv for Windows is the Data Modeling Desktop, which will ship with the next release of Quattro Pro for Windows. It lets you turn a jumble of spreadsheet information into a neatly organized, easily malleable crosstab report. You may freeze or link a report to its source data, and to pivot the table, all you need to do is click and drag.

Like the similarly named Database Desktop (Quattro Pro for Windows' engine for querying external data files), the Data Modeling Desktop is a separate Microsoft Windows application that may be launched from within Quattro Pro. On startup, the Data Modeling Desktop asks you to specify a range of source data and a worksheet range to which the finished table may be copied. That data source may be any worksheet table headed by labels.

A copy of your source data appears in a window at the bottom of the workspace. To build the table, you click on columns in this source window and on icons located on the Speed Bar. To turn a source field into column headings, for example, click once on the field and once on the column-heading icon. To enter numbers in the table's data area, click on a field and on another icon. The software assembles your table piece by piece, click by click, so you can reverse any mistakes immediately. (There's no Undo command, but you can delete a table element at any time.)

Alternatively, if you don't want to use icons, you can simply drag source fields to the appropriate functional areas of your nascent table. One wonderful user interface feature: As you drag fields to a table region, the software confirms your move by highlighting the corresponding Speed Bar icon.

LABEL IT

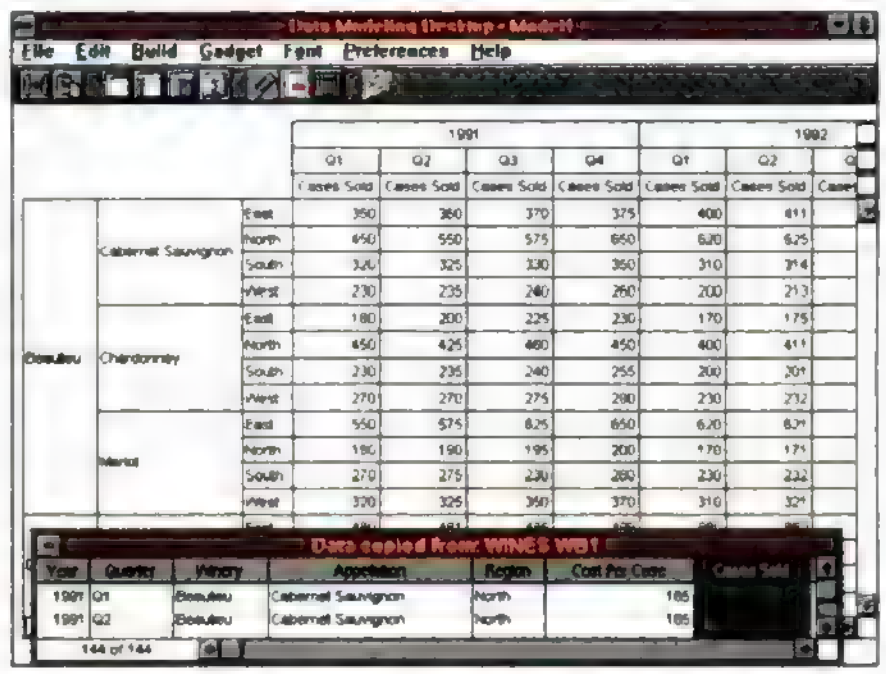
White blocks accompany each column and row heading in the table. These handles let you reorganize the report; their function is analogous to dragging category tiles in an Improv worksheet. As with Improv, you can stack headings along the column or the row axis and change the layering to suit your needs.

Source labels that become row and column headings are alphabetized by default, but you can move them around with the mouse. For example, you'll undoubtedly want to put them in chronological order.

Numeric values in the table's data area are summed by default, but you can pick a different formula by selecting another one from the formula "gadget" (a set of related commands in a separate window). The options include average, count, percent of column, percent of row, percent of grand total, and item-to-item change (absolute or percent), but not standard deviation or variance. To aggregate this data with two or more formulas, just drag the field into the table more than once and apply the formula gadget.

The Data modeling Desktop can also add group summary data to your table, such as quarterly subtotals or yearly grand totals. And items along either axis can be grouped; just select a set of adjacent items and click the paper-clip icon. The Data Modeling Desktop collapses the members, rolls up their data by using the aggregation formula you've selected, and displays an asterisk in the collapsed heading to let you know that subordinate data is hidden. You can rename that heading (and remove the asterisk) by selecting it and clicking on an option within—what else?—the Name gadget.

When you're satisfied with your table, a click on the spreadsheet icon sends the table back to the designated spot in your Quattro Pro for Windows notebook. If you've asked for a hot or cold link, the software creates the table via a DDE link. Otherwise, you get a static copy. □



Quattro Pro for Windows incorporates some of the data modeling capabilities found in new products, like Lotus Improv for Windows.

The accompanying figure illustrates a simple DS Lab model incorporating all the available element types. The triangle (Price) is a constant that the user may want to vary from one model run to the next. This is the model's "what if" element. When the model is run, a dialog box will ask you to supply a value for the triangle. The square (Fixed Cost) represents a constant that will not change from run to run.

The circle with crosshairs (Units Sold) is an array input called a series—a set of values, each of which is tied to a particular processing iteration. The grid (Unit Cost) is a table array input, which is simply a set of values that are typically used for lookups. In this model, sales are seasonal, so Units Sold values vary by month (hence by modeling iteration). Unit Cost is a lookup table. The remaining elements, symbolized by circles, are variables derived from scripts.

LAB TALK

DS Lab's scripting language is direct and powerful, and its function library is

The Choice Is
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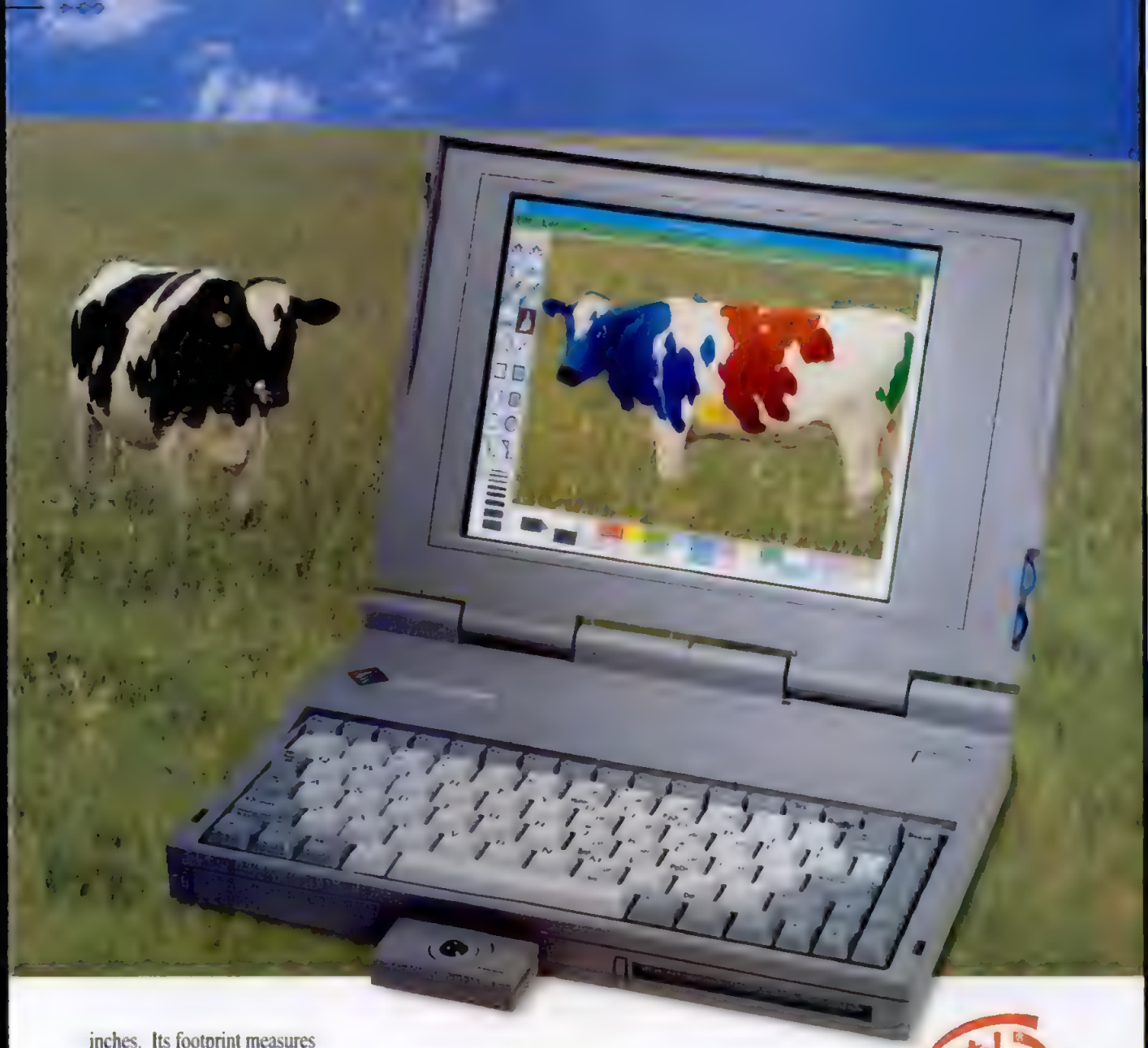

inches. Its footprint measures
only 11.7 x 8.5 inches, and it weighs just 5.4 pounds.

486 Power

You don't have to sacrifice performance to have color, either. ColorBook models are based on Intel® 486 processors. Both ColorBook models include a floppy drive, 4MB or 8MB of RAM (upgradeable to 20MB), and a large, fast hard drive. These notebooks are powerful enough to become your only computer!

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The ColorBook includes a built-in track ball, which is much easier to use than a mouse in most portable situations. You also get two PCMCIA Type II card slots so you can plug in dozens of available PCMCIA peripherals.

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Introducing The ColorBook!

For the same money, you can have a black-and-white 486 notebook. Or you can have a color 486 notebook. Which is it going to be? Hay, it's not too hard to spot the best deal: the ColorBook from Gateway 2000! The new ColorBook has everything you're looking for in a portable at a price you'd expect to pay for a monochrome system. That's a special breed!

Exploding The Myth

Why do you expect to pay so much more for a color portable? Because other manufacturers always charge a plump premium for color. They've been milking the market, brainwashing you into thinking high-quality color costs a lot more to manufacture. It doesn't! We're selling the ColorBook for our usual cost-plus-small-margin. Now other companies will have a hard time perpetuating the color portable price myth. (Competitors absolutely *hate* us! Isn't it great?)

Experts' Reaction

We gave several PC trade publication editors a sneak preview of the ColorBook. Here's what they said about it: "Way cool!" "Dead on." "You won't be able to make enough of these."

Dazzling Color Display

The editors were impressed by the bright, crisp color graphics from the latest-technology, dual-scan STN display. It's a 9.4-inch VGA LCD, backlit for use in any lighting conditions. The editors said the ColorBook has the best STN color display they had ever seen! When they learned one model was priced *less than $2,000*, they were convinced the ColorBook will cause a stampede in the industry.

No Compromise On Size

Adding color to a portable usually means adding weight and bulk. Not so with the Gateway 2000 ColorBook. The ColorBook is the thinnest color notebook on the market — 1.77

Introducing The ColorBook!

The ColorBook is the thinnest color notebook on the market — 1.77 inches. Its footprint measures only 11.7 x 8.5 inches, and it weighs just 5.4 pounds.

You'll appreciate the convenience of using PCMCIA cards. They're as easy to carry as credit cards, and they plug right into your ColorBook.

The integrated track ball slides out from a compartment by the space bar on the keyboard. You simply pull it out and go to work. Finished? Just slide the track ball back into the ColorBook.

FEATURES

Size

With the ColorBook, you get great color at a great price while maintaining excellent portability.

Intel® 486 Processor

ColorBook notebooks are based on Intel 486 microprocessors, which makes them powerful enough to serve as your desktop PC with an external mouse, keyboard and monitor. Supports simultaneous video, up to 1024 x 768 resolution.

Dual-Scan STN Color Display

Dual-scan STN color is the latest technology in portable color displays, and it looks fabulous! You get 256 colors with the ColorBook running in VGA mode (640 x 480 resolution).

PCMCIA Type II Slots

Add a modem, network card or any of dozens of available PCMCIA-compatible peripherals. The ColorBook's two Type II slots can also be used for one Type III PCMCIA card.

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- Parallel, Serial & PS/2 Mouse Ports
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- Suspend/Resume Feature
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uncommonly rich in particular areas. The program includes advanced future- and present-value functions (allowing for regularly and irregularly changing cash flows), bond functions, inventory management functions (for calculating economic order quantities, reorder points, safety stocks, and service levels), and functions for managing investment portfolios. The statistical functions are more limited than those offered by current spreadsheet apps, and the engineering functions (aside from the usual trigonometric and other math items) are nil.

DS Lab has a few user-interface shortcomings. The toolbars need legends, and some of the report windows hang around after their parent models have been closed and sent to disk. The print menu could benefit greatly from a compress-to-fit option. (You can choose from several fixed zoom levels, but automatic fitting would be more useful.)

The most serious drawback: The Clipboard cannot transfer currency formats to Lotus 1-2-3 for Windows, because Lotus 1-2-3 won't accept input beginning with the characters "+$". Lotus users will have to work around this problem until DS Group finds a solution.

DS Lab's diagrammatic approach to modeling is elegant, sensible, and a potential productivity booster. You might want to try the smaller-scale product first: For the first 90 days, you can get full credit on an upgrade to DS Lab Pro.

▶ FACT FILE

DS Lab, Version 2.0
DS Lab Pro, Version 2.0
DS Group Inc., 474 North St., Greenwich, CT 06830-3449; 800-828-8760, 203-861-1833; fax, 203-869-8519.
List price: *DS Lab, $195 (until October 1); DS Lab Pro, $995 (until October 1).*
Requires: *2MB RAM (4MB recommended), 2.5MB hard disk space, Windows 3.1, DOS 5.0 or later, mouse.*
Circle 446 on reader service card

Power Thinking Corp.

FreeThink

Power Thinking Corp.'s FreeThink, Version 1.0, is a desktop powerhouse uniquely suited to users who analyze massive amounts of data organized into multiple layers of aggregation. (The vendor explains this in somewhat more esoteric terms, describing the package as a "Wittgensteinian alternative to the traditional Aristotelian subject-predicate information model.") Until October 1 FreeThink will cost $139 (after which its price will be $695).

Let's say you're doing econometric studies on developing nations. With two keystrokes, you can switch FreeThink from a view showing a variable aggregated across all countries and time periods in your database, to one that shows the same variable computed by region and by five-year period. Repeat those keystrokes and you're looking at data by country and year. You can repeat this for as many levels of organization (or resolutions, in FreeThink-speak) as you would care to use.

FREE LOOK

FreeThink's view map (a spreadsheet-style display format) holds only two axes: columns and rows. But each cell in this matrix can display the outcome of many consolidations. Each row-and-column intersection can also display many variables (up to a theoretical maximum of 32,000). In the accompanying figure, each cell shows two variables (known to the model as NE.EXP.GNFS.US and NE.DAB.TOTL.US), but simple keystrokes let you expand the cell to show additional or different variables. Obviously, in this case you're not going to expand a cell to show thousands of separate numbers. But pressing a function key at any row-and-column intersection pops up a window in which you can scroll through all values relevant to that intersection.

Another function key pops up the formula and any comments associated with the current variable. Yet another function key enumerates the variables that supply input to the current variable. But unlike Information Resource's Javelin Plus, FreeThink doesn't offer a diagrammatic display of variables' antecedents and consequents.

To help you manage complex data structures, FreeThink offers both a macro facility (with a recorder) and an unusually compact formula syntax. And to handle missing values, you can embed proxy functions in your formulas. A proxy function is evaluated only if the formula's previous element cannot be evaluated. Like an @IF function in Lotus 1-2-3 (but with a more terse syntax), it can save you from model-breaking divisions by zero and will prove indispensable to those who have to pull in large amounts of data from disparate external sources.

PLUS...

Other valuable FreeThink features include the ability to create named sorting sequences, the ability to set any number of conditions as determinants of a variable's display color, and flag variables that display particular extended ASCII characters when particular conditions are met. The conditional display colors can be based on the values of any variables, not just the one to which the color will be applied.

Each cell in this FreeThink screen shows two variables, but simple keystrokes expand the cell to show additional variables.

The company says that users of statistics packages are a natural constituency for FreeThink, but unfortunately the current version offers no direct connections with stat programs. A Windows version, which is under development, will remedy that deficiency.

In the meantime, however, Version 1.0 can import ASCII and .WK1 data. Oddly enough, you can't grab .WK1 data by range name, but you can use some exotic formulas to pluck values based on spreadsheet label headings. The expres-

Excel's Crosstabs Get Pivoted

by Craig Stinson

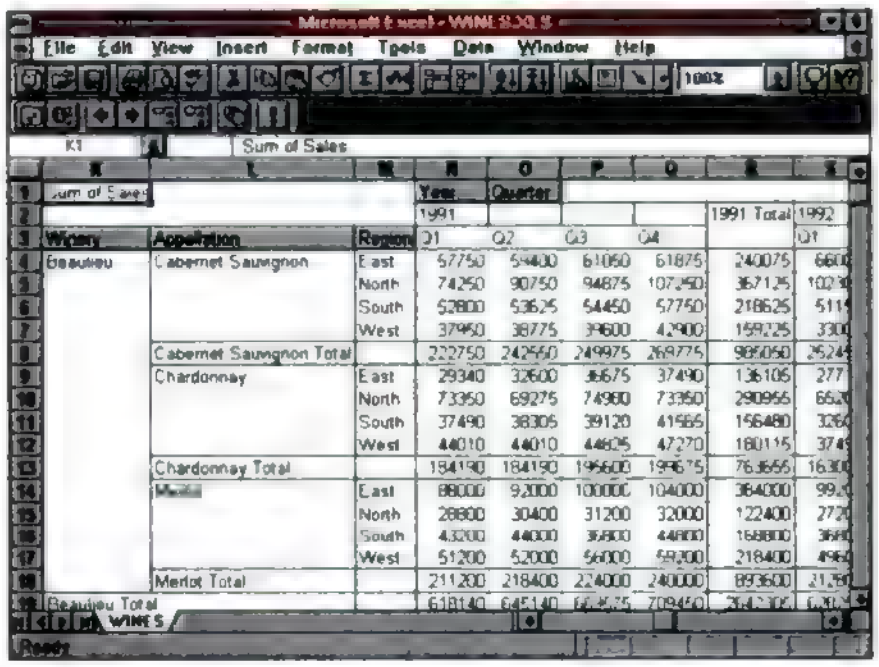
Microsoft Excel's next release, like that of Quattro Pro for Windows, will include a tool for transforming flat lists of information into dynamic crosstab reports. Users of Excel 4.0 will recognize the new feature as a simplified and expanded version of Crosstab ReportWizard, but Microsoft Corp. has changed the name to PivotTable Wizard to emphasize the package's similarity to Lotus Improv for Windows. A PivotTable can indeed be pivoted; just drag the field buttons between the table's column, row, and page areas to transpose the table's layout.

The data source for a PivotTable can be one or more lists on any worksheet, whether or not the lists have been defined as databases. If you supply more than one list, PivotTable Wizard will consolidate them for you. You can also feed the software any external data file supported by Microsoft Query, the querying tool that will be shipped with Excel 5.0. (Query will provide Excel users with a subset of Microsoft Access's functionality, in much the same way that users of Quattro Pro for Windows get a piece of Paradox via the Database Desktop.)

THE GUIDE

PivotTable Wizard steps you through the process of specifying data and positioning fields. You simply drag the names of your fields into column, row, page, and data zones. If you put one or more fields in the page zone, the resulting table displays two-dimensional slices; it lets you step through the slices via drop-down lists. By clicking on the Show Pages tool, you can also spread the slices across separate pages in your workbook—in effect, creating a series of separate PivotTables.

Numeric fields in the table's data zone are summed by default, while text fields are aggregated with the COUNT function. Rather than build the table step by step, as Borland's Data Modeling Desktop does, PivotTable Wizard uses buttons to show what it's going to do, saving the calculation and display of numbers until you hit the finish line. For example, you might see a Sum of Sales button in PivotTable Wizard's data zone. If you wanted averages instead, you could double-click on this button and choose Average from the drop-down list that appears.



The upcoming Microsoft Excel 5.0's PivotTable Wizard will let users manipulate complex data structures with relative ease.

The finished table is automatically supplied with subtotals and grand totals, and is warm-linked to the underlying data. To refresh the data, you click on a button on a special toolbar that appears while the table is selected. Changing a finished table's layout is just like rearranging a worksheet in Improv: Simply drag category identifiers from one axis to another. Provided you've assigned one of Excel's "auto formats" to your table, Excel will correctly maintain the formats no matter how you rearrange the table.

Items within a category are normally sorted in ascending alphabetical or numerical order, but you can rearrange the items by moving them with the mouse. You can also define custom sorting orders; for example, you can always make your company's store locations appear in a particular nonalphabetical order.

You can group items in a finished table. A set of daily entries, for example, can be grouped into monthly or quarterly aggregations. A set of part numbers could be aggregated as 1 to 99, 100 to 199, and so on. Buttons on the PivotTable toolbar then let you hide or reveal group details as needed.

Finally, if you select any part of a finished PivotTable and click on the ChartWizard tool, Excel will plot your table for you. If you then rearrange the layout of the table, the chart will automatically reorganize itself as well. □

sion "&'Sales Total',@TP,@SP", for example, returns the value of a particular cell in the region below and to the right of the label Sales Total—the cell that's bounded by the same row and column headings as the current FreeThink viewmap cell.

Spreadsheet users will also appreciate the ability to browse Lotus 1-2-3 files without leaving FreeThink, as well as the program's versatile .WK1 export. The complete support of spreadsheet lingua franca somewhat mitigates the fact that FreeThink has no charting capability.

POWER SOURCE

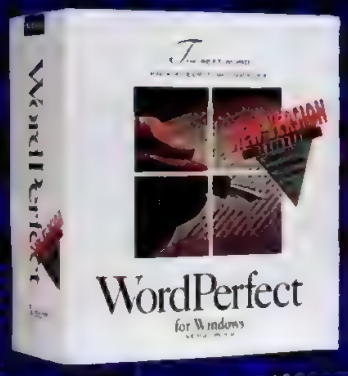
As you might surmise, complexity is the price of power in using FreeThink. This is not a package you will be able to master in an afternoon or a week of afternoons. While the end result of a complex aggregation layering may be a model that's both powerful and elegantly browsable, the process of constructing such a model is not simple. You will need to spend much time building tables of connections by using a keyboard interface that feels old-fashioned by today's standards. This may be replaced with a more accessible interface when the Windows version

THE PERFECT PC

PC MAGAZINE EDITORS' CHOICE

January 26, 1993
466 Magnum

THE PERFECT SOFTWARE



MICRON MEANS... QUALITY

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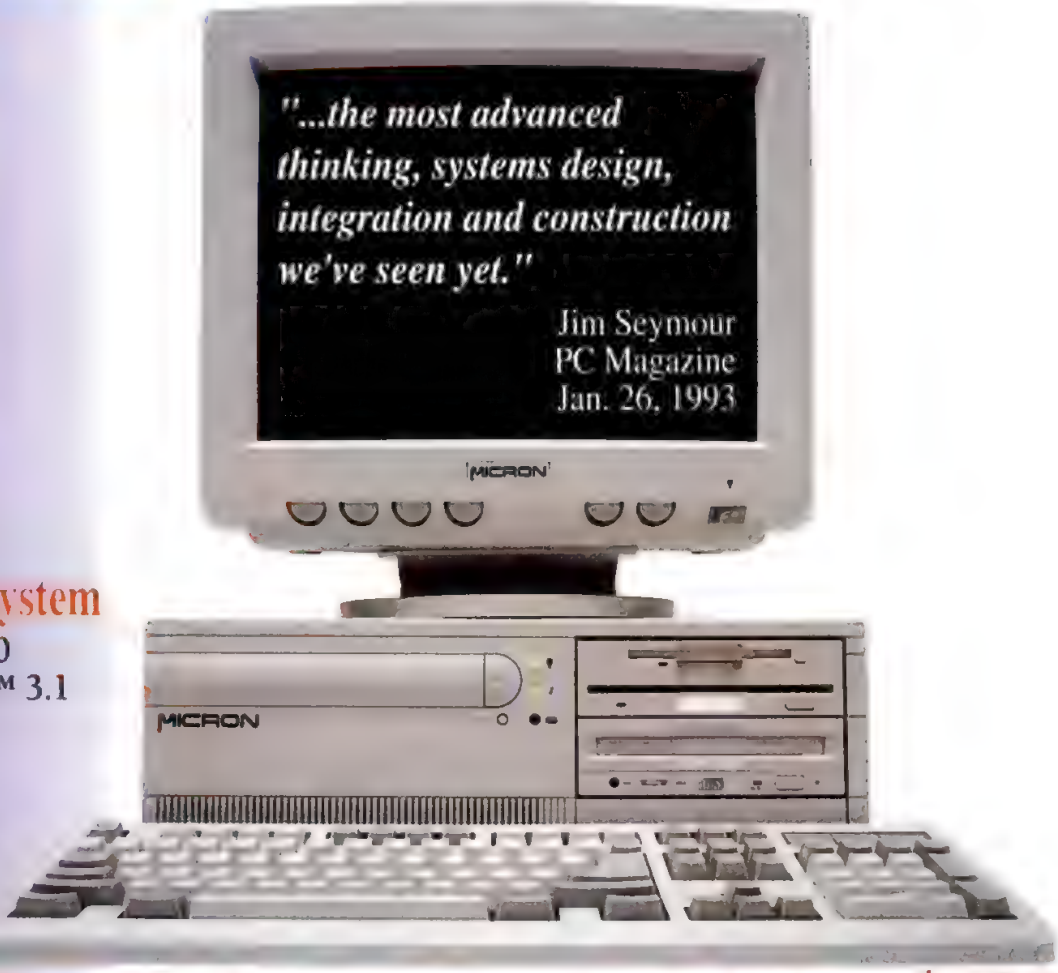

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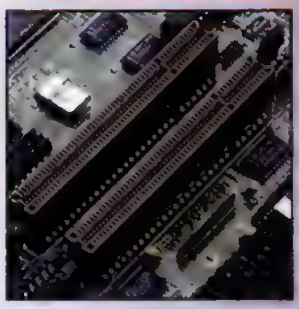

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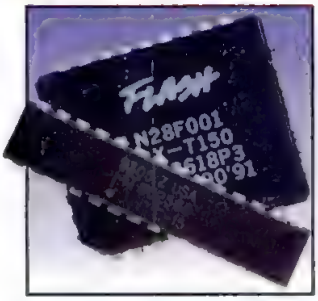

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arrives. That release is expected sometime next year.

FreeThink will impose a relatively new vocabulary on you, as well as a new way of modeling. A display format, for example, is called a representation setting, and the user interface is made up of items named interaction objects. Even if this is the first modeling package to break away from the Aristotelian mold, some of its vocabulary seems to be unnecessarily opaque.

Even so, if large-scale modeling power on the desktop is what you need, do not be deterred. This package is worth looking at.

▶ FACT FILE

FreeThink, Version 1.0
Power Thinking Corp., 2 Belanger Pl., Suite F, Northampton, MA 01060-3355; 413-585-0692; fax, 413-584-2339.
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Requires: *2MB extended memory, 2MB hard disk space, DOS 3.3 or later.*
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FuziWare Inc.

FuziCalc

The problem with most spreadsheet models, according to FuziWare, is that they are founded on uncertain inputs. When the precision of your sales forecast is no better than plus or minus 10 percent, why bother calculating the margin to the fifteenth decimal place? Fuzz in, fuzz out.

The $99 FuziCalc, Version 1.11, is a spreadsheet designed to help you cope with the fuzz. A FuziCalc model recognizes two kinds of values. A value whose magnitude is certain (your rent, perhaps) is called *crisp*. One that can only be estimated (such as interest rates or inflation) is *fuzzy*. Any number calculated from one or more fuzzy inputs is itself fuzzy. Small gray triangles flag all fuzzy values on worksheets and printouts.

The folks at FuziWare believe that most people doing forecasts on spreadsheets know enough about their circumstances to describe uncertain inputs in simple, nonstatistical terms, but not enough to estimate the range of outcomes that can arise from the interplay of many uncertain inputs. Describing that range of possibilities is FuziCalc's job.

A WARM FUZZY

When you enter a fuzzy value on a worksheet, FuziCalc asks you to describe it visually with a belief graph. The program default is a triangular probability distribution, in which the apex indicates the value you think most likely, while the two corner points represent minimum and maximum values. A small gallery of alternative shapes is available, each of which you can modify by clicking and dragging. For example, if you think values in a given range are equally probable, you could choose FuziCalc's trapezoidal belief graph. Another gallery shape is suitable when two disjunct values are equally likely (for example, sales may be around $100,000 or $150,000 but probably not exactly $125,000), and so on.

After you've drawn the belief graph

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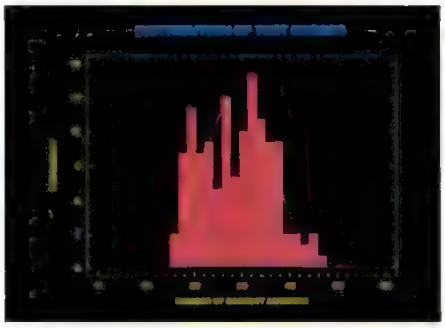

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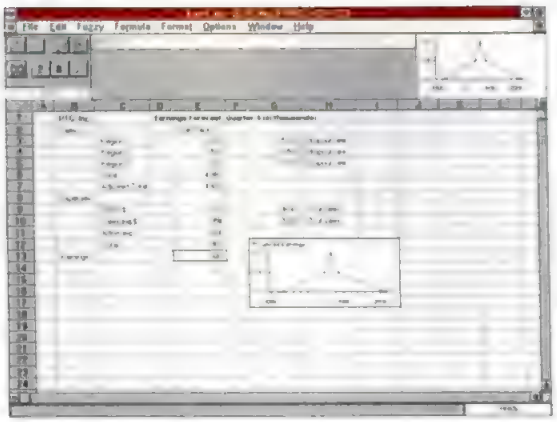
for a cell, the cell displays what FuziCalc calls its centroid value. This is the point at which the graph, were it a physical object, could balance on a knife point. As you scroll through your model, selecting fuzzy cells, the program redisplays each cell's belief graph in miniature in the upper-right corner of the window. You can double-click on any fuzzy input cell to study or edit the cell's belief graph.

When you build a formula that references one or more fuzzy inputs, FuziCalc automatically generates another belief graph to characterize the output. You can double-click on this one to get quantitative details, but you can't edit it.



FuziCalc lets users implant any belief graph on a worksheet and incorporate it into a printout.

TO ADD OR NOT TO ADD

You may recognize some superficial similarities between FuziCalc and Monte Carlo–style modeling programs, such as Decisioneering's Crystal Ball and Palisades Corp.'s @RISK. (See "Application Add-Ins: Mix-and-Match Featureware," February 9, 1993.) These add-ins, however, are intended for a more sophisticated user. FuziCalc won't let you describe uncertainties in statistical terms (no Poisson distributions, please) and won't intimidate you with the formal language of probability.

While its easy learnability and nonthreatening manual are pluses, many users will find FuziCalc too low-powered to be useful. The program's belief graphs are short on information and the documentation never clearly states what the numbers on their *y*-scales actually mean. (They don't indicate the probability of outcome, even though they range from 0 to 1.) And while you can implant any belief graph on the worksheet (see the accompanying figure) and incorporate it on a printout, there are no options for printing a summary of a model's uncertainties.

Also, the spreadsheet is short on analytic power and lacks some standard interface amenities. The function set is minimal, there are no graphics or database services, and this is perhaps the only spreadsheet you can buy that won't let you reference cells by navigating to them with the keyboard. The program's inability to import spreadsheet formats other than SYLK makes it a blunt tool for analyzing .WK1 models.

If you use another Microsoft Windows spreadsheet and don't mind transferring data via the Clipboard, consider adopting FuziCalc as an inexpensive accessory.

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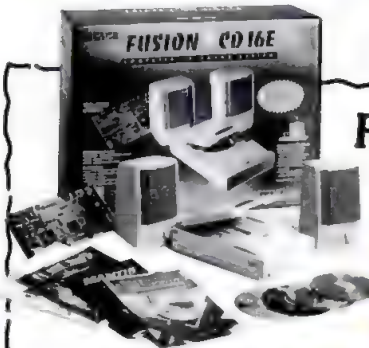

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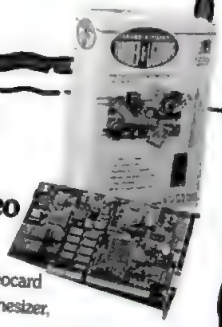

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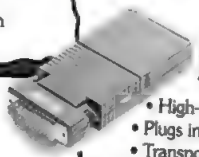

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FuziCalc, Version 1.11

FuziWare Inc., 316 Nancy Lynn Ln., #10, Knoxville, TN 37919; 800-472-6183, 615-588-4144; fax, 615-588-9487.

List price: *$99.00; free upgrade for registered users.*

Requires: *386 processor with math chip, 4MB RAM, 4MB hard disk space, Microsoft Windows 3.1 or later, mouse.*

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Information Resources Inc.

Javelin Plus

Javelin was conceived in the mid-1980s, around the time that Release 2.0 of Lotus 1-2-3 came out. That it was revolutionary then was its undoing, as the market expressed a resounding preference for evolutionary progress. Today the market is larger and more sophisticated, and Javelin—its virtues and unique ways—is still there for your consideration.

Information Resources, the product's current owner, has said that Version 3.5 of Javelin Plus, released in late 1992, will be the last upgrade for Javelin qua Javelin. Sometime in 1994, Javelin will make a new appearance as front-end technology for Windows Express, the upcoming reincarnation of IRI's decision-support software system. IRI assures us that it will continue to sell and support Version 3.5 as a standalone product, however.

THROWN FOR DISTANCE

Javelin provides numerous distinct "views" onto a centrally stored modeling database. The worksheet is only one such view. Other views include diagram, which traces the roots and branches of formulas diagrammatically; formulas, which lists all formulas in a model; table, a tabular display of a variable's values; notes, an editor/viewer for free-form annotations; errors, a list of any formula errors found; macros, an editor/viewer for macro code; and three types of graph windows. One of the graph windows displays a character-mode bar graph of the current variable, another displays the current variable as a graphics-mode line chart, and the third provides a variety of chart

Can CA-Compete! with Improv?

by Craig Stinson

Like Lotus Improv for Windows, only more so, the beta Version 5.0 of CA-Compete! is a multidimensional modeler that preserves the familiar look and feel of a conventional spreadsheet program. To be specific, it does its work in an environment that looks a great deal like that used by Microsoft Excel 4.0.

ManageWare, the company that sold the product prior to its acquisition by Computer Associates International, struck an agreement with Microsoft Corp. that let ManageWare imitate Excel's interface, function library, range-naming features, and other matters to a fine level of detail. Excel users looking for multidimensionality may therefore come up to speed more quickly with CA-Compete! than with Improv.

As with a conventional spreadsheet program, CA-Compete! formulas are entered into cells and displayed in a control panel. Referencing items in a dimension is simply a matter of clicking on row and column headings and supplying the appropriate operators, but CA-Compete! then asks you whether you want your formula's scope to be local (relevant only on the currently displayed data slice) or global.

To help call attention to a formula's scope (since there is no separate formula window), CA-Compete! displays the outcome of local formulas in one color and global formulas in another. It displays constants in a third color.

CA-Compete! can handle up to 12 dimensions per model but displays only 2 at a time. Unlike Improv (or the cross-tabulation features in upcoming versions of Quattro Pro for Windows and Excel), the program does not let you stack dimensions along an axis. You can use the mouse to swap any two dimensions onto the displayed grid, however, or to transpose the two that are currently in view. A simple menu command allows you to turn slices into separately named views.

COMPETITION

CA-Compete! does not provide additional methods of aggregating data. You can add subtotaling items, of course, and hide rows and columns to suppress unwanted detail. But the program offers no particular assistance in this area.

CA-Compete! does have some unusual analytic tools, however. A feature called Terms lets you apply a computation to a gridful of numbers without affecting the values stored in the underlying database. For example, you might create a term to convert absolute dollar-cost figures into percentages of gross sales.

Terms are handled somewhat like named styles (which the program also supports); a drop-down list located above the grid shows you what term if any has been applied to the current cell. Other tools include goal-seeking, allocation (spreading a summary value across a range of input cells), interpolation, extrapolation, and a curve builder.

The package also comes supplied with a respectable conventional spreadsheet in addition to the multidimensional modeler. You can copy the current slice to this spreadsheet and play "what if" without affecting the underlying model. Or you can use the spreadsheet as a flat-file database and build formulas in the modeler that reference database records.

New features in the soon-to-be-shipped Version 5.0 will include charting, a tool bar, support for Microsoft Windows 3.1's common dialog boxes and multiple-document interface, and a macro language with a recorder. Apart from the charting, however, CA-Compete!'s analytic and display capabilities do not appear to have advanced since its last release. □

types for up to seven variables.

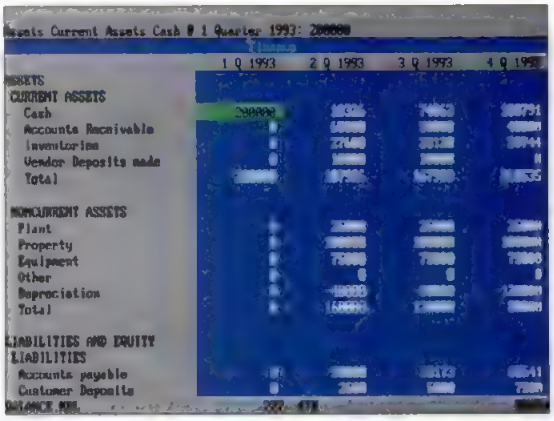
The various views are not merely reporting vehicles. Several of them play a dual role, acting as both viewers and data-entry modes. For example, you're welcome to create new aggregate variables (the total of a set of items, for example) on the worksheet. Just select a cell and exercise a menu command and the summary variable becomes part of the database. In the two single-variable graph views, you can even add or alter constant (nonformulaic) data by manipulating chart markers. Unlike true spreadsheet-oriented modelers (such as Lotus Improv and CA-Compete!), however, Javelin protects you from destroying worksheet data. Deleting a column on Javelin's worksheet has no effect on the underlying data.

PINPOINTING TIME

Every variable in Javelin has an implicit time dimension, including a start date, an end date, and a periodicity. The built-in standard periodicities include yearly, quarterly, monthly, weekly, and daily. This arrangement facilitates data entry, interpolation and extrapolation along the time axis, the conversion of values from one periodicity to another, and various other time-oriented calculations.

For example, to enter monthly sales figures, you can simply go to Table view for a new variable named Sales, and fill in the time slots that appear there. When converting values from a smaller to a larger time unit, you can specify one of three methods: sum, average, or last value. (The last-value method would be appropriate for tracking an asset.) When converting from a larger unit to a smaller one, you can choose from three splitting methods: divide, interpolate, and repeat. The interpolate method spreads component values along a trend line. The divide method lets you choose between even divisions and divisions that account for varying numbers of days per month and per quarter. These unusual elements of time intelligence constitute Javelin's principal strength.

For values that don't fit the standard periodicities or have no time component, you have to do a little extra work. A Javelin model can have two user-defined calendar-oriented periodicities—A and B—each of which must be defined in terms of one of the standard periodicities. For example, to record biweekly data you



Javelin Plus's worksheet borders piece together the variable name from the labels' indentation hierarchy.

Oh sure, they tell you they've got an accounting system that operates under Windows and has promising new functionality. But before you take the bait, take a closer look.

Some accounting tempt you with can be very

Find out if they truly offer a full Windows solution today. Or are they baiting you with a promise? Will it integrate with their DOS product? Is there an easy path to Windows? How much does it cost? Will you need retraining and new hardware? When will their product be available? A year from now? Two? Can you wait that long? Furthermore, have their systems been thoroughly tested?

Chances are, you'll discover the technology they're trying to lure you with has more holes than a hunk of Swiss cheese.

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might declare that periodicity A has a frequency of 26 per year. The slots in Table view would then appear as "1 A 1993", "2 A 1993", and so on. For data completely unrelated to the calendar, you can choose Record Periodicity.

CATEGORIZED

Meanwhile, Javelin handles other kinds of dimensionality by treating every word in a variable name as an implicit category. When you construct a worksheet, you tell Javelin what you want to see by positioning words in variable names along the worksheet's "smart" borders.

For example, you have two variables—Assets Current Assets Cash and Assets Current Assets Accounts Receivable. As the accompanying figure shows, you can display values for these variables by using successive indentations along the row axis. The program pieces together the variable names and plucks out the appropriate numbers. The figure shows the time dimension on the column axis, but you could put components of variable names up there instead of or in addition to time. A cell at the intersection of a row labeled "Topeka" and a column labeled "Sales" would display the value for Topeka sales. Expanding the column border to two lines and placing "Sales" below "1 Q 1993" would get you first-quarter Topeka sales—and so on.

If you put a label in the intersection of the two axes, it is applied to everything in the worksheet. For example, you could get first-quarter Topeka sales by typing "Topeka" in the axis corner, "Sales" on the row axis, and "1 Q 1993" on the column axis. On a separate worksheet, you could extract information for Wichita, Lawrence, and Kansas City.

FALLING SHORT

Unlike all the other multidimensional modelers in this review, as well as the crosstab generators in Quattro Pro for Windows and Microsoft Excel, Javelin offers no method for transposing worksheet dimensions. If you want your data sliced another way, you must build another worksheet. (Your model can have as many as you need.) In this respect, the otherwise ingeniously designed Javelin interface has begun to show its age.

Javelin also lags behind in presentation issues. There's no way to make headings underlined or bold (let alone to choose a contrasting font or color).

Javelin is a smart program that needs a face-lift. Unfortunately, as a standalone item it's not going to get it.

▶ FACT FILE

Javelin Plus, Version 3.5
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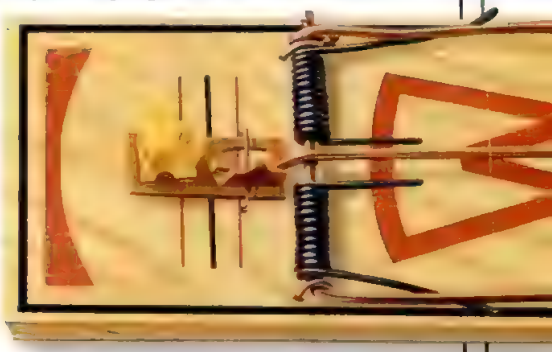

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Lotus Improv for Windows, Release 2.0, bears a more than passing resemblance to conventional spreadsheet programs. This multidimensional modeling tool is particularly well suited for Lotus's own constituency.

With Improv, the row-and-column grid is both your presentation vehicle and the place where models are built. Variables are created directly as row-and-column headings, and input values are typed directly into cells. Formulas reside in a separate formula pane, not in cells, but you may build them much as you would in a traditional spreadsheet: by pointing to items you want to reference.

IMPROVISATION

An Improv model consists of one or more related worksheets, each of which can be displayed in many different views. Typically, you'll use separate worksheets to display different sets of variables and views in order to show a given variable set in differing transpositions.

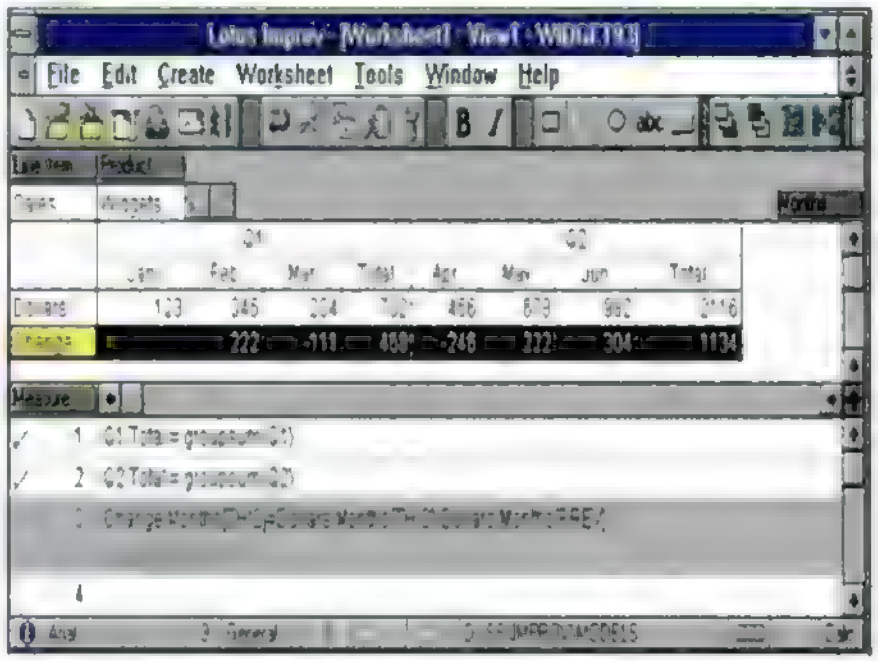
A model may also include charts as well as scripts. Improv is the first and currently the only Lotus application to support the BASIC-like LotusScript. Although its macro language is incompatible with that of Lotus 1-2-3, Lotus 1-2-3 for Windows will eventually support LotusScript as well.

An Improv worksheet may display up to 12 categories (dimensions) deployed along three axes: column, row, and sheet. You can position up to four categories along each axis. For example, three categories—Years, Measure, and Line Items—can be stacked along the column axis, and Improv simply replicates the subordinate structures for each item in the top-level category. These categories can then be independently rearranged. This ability to stack categories along an axis makes Improv a more versatile presentation tool than CA-Compete!, its most similar competitor.

Transposing categories in Improv is really quite easy. All you have to do to transform an arrangement is pick up the Years category title and drag it below Line Items. To pivot the table, you could drag all three column tiles to the lower-left corner and drag one of the row titles to the upper-right corner. (For more information, see the sidebar "Modeling Multiple Data Dimensions: A Few Steps Through the Looking Glass.")

3-D GROUPS

Variables may be aggregated into groups as well as into categories. Groups are preferable for lumping together asymmetrical collections of items. If your sales are organized by country, for example, you might create one group for England, France, and Germany; and a second group for Japan, Taiwan, and Korea. You would not create a category called Continents, because Improv would then replicate each country within each continent, and your model would have useless placeholders for the France item under Asia, the Taiwan item under Europe, etc.



In Lotus Improv for Windows, even a single group summary item can damage a model's logic.

Each group may have one automatic summary item to perform some aggregate calculation, such as a sum or average. A simple menu command lets you collapse the group to display only the aggregate formula. Unfortunately, if you want to insert additional aggregate formulas, you forgo the convenient collapsibility. Displaying a series of aggregation formulas without the intervening details requires that you hide columns and rows.

More seriously, even a single group summary item can damage the logic of a model if you've already inserted what Improv calls recurrence formulas into the model. In the accompanying figure, for example, the month-to-month change formula (Change.Months[THIS]=Dollars.Months[THIS]-Dollars.Months [PREV]) has been effectively broken by the intrusion of a group summary item that calculates quarterly totals. When one worksheet is used to provide input for another, re-sorting items in the source worksheet can break the formulas in the destination sheet.

What Improv offers that ordinary spreadsheets do not is formula generality, formula self-documentation, the ability to model many dimensions of information, and the ability to transpose those dimensions with abandon. But unlike some other multidimensional programs, Improv doesn't let users move easily between multiple levels of aggregation, doesn't make input cells easily distinguishable from formula cells, and by itself provides no means of tapping into server-based data. (Release 2.1 includes a starter version of Q+E Extend, a module that provides access to PC and SQL database formats.)

Also, because the worksheet is the data structure, an accidental row or column deletion if not immediately undone deletes real data, not just its visual representation.

On the other hand, many users will find that Improv's user interface and compatibility with other Lotus applications make up for its lack of industrial strength. With its SmartIcons on top and its live status bar below, the Improv interface makes the user of other Lotus Windows applications feel right at home. The import/export services for Lotus 1-2-3 and Microsoft Excel are reliable and exceptionally versatile.

Because of its basic spreadsheet style and its design commonality with other Lotus programs, Improv may well be the ideal accessory for the advanced Lotus 1-2-3 user who sometimes needs more than 1-2-3 can deliver. Lotus itself appears to see the product in that light. □

▶ FACT FILE

Lotus Improv for Windows, Release 2.0
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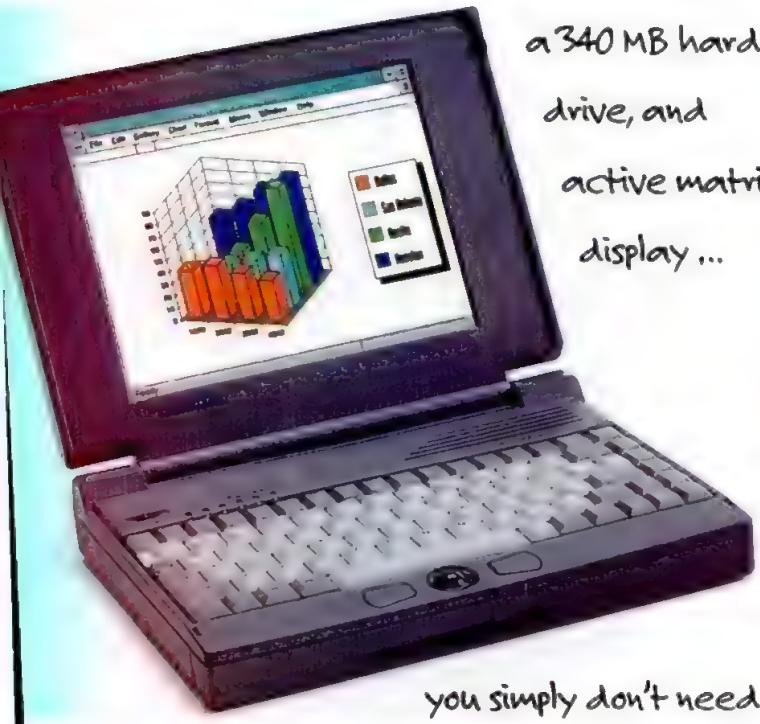

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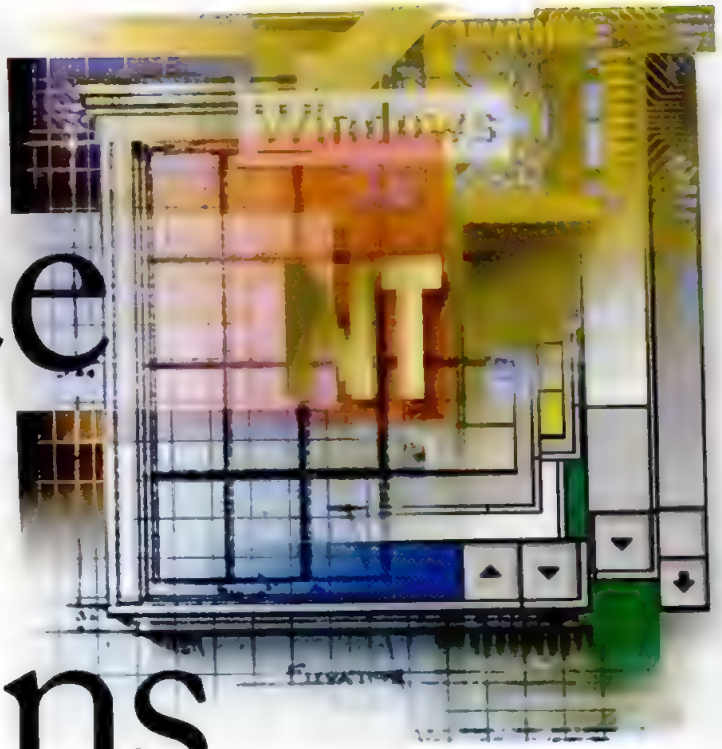
Windows NT: See How It Runs



by Rick Ayre and Robin Raskin

Months before it shipped, Microsoft's Windows NT was causing a hubbub. It generated more than its fair share of speculation about the benefits of a true multitasking, multithreaded OS—one that had the added advantage of using the familiar Windows interface. Now, after a long and ambitious development cycle, NT is ready, but who amongst us is ready for it? Setting aside the hype, *PC Magazine* set out to discover the real story about NT in action.

First, a quick review of the highlights. Windows NT is a 32-bit operating system every inch of the way. That means instructions are executed faster, the 32-bit graphics engine and 32-bit device drivers draw screens faster, and the I/O to various storage systems is handled faster.

It is also a preemptive multitasking and multithreaded system. Multiple applications can each be run in their own protected spaces at the same time. Specially written applications can have subtasks (threads) that let them perform more efficiently. NT also debuts a brand-new file system (NTFS) that replaces the DOS FAT system and provides some new benefits, such as long filenames.

Lists of features don't tell everything about Microsoft's 32-bit operating system. PC Magazine Labs' in-depth look gives the true story of Windows NT's performance.

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Illustration by Jeff Brice

NT and the API Jungle

by Charles Petzold

It used to be simple: Programmers wrote applications for a particular operating system; users installed that operating system to run those programs. This one-to-one correspondence is no more. For this reason, it has become useful to differentiate between operating system products and application programming interfaces (APIs).

An *API* is a formal definition of a collection of function calls (and other protocols) that a program uses for communicating with the outside world. The communication may take the form of accessing memory, a file system, or a network; obtaining user input from the keyboard and mouse; displaying text and graphics on the video display and printers; capturing and playing sound and music; launching other processes; dividing a program into multiple threads of execution; and communicating with other programs.

An API also usually implies a certain memory organization and integer length (usually either 16 or 32 bit), as well as the file formats of device drivers, executables, and dynamic link libraries.

An *operating system*, on the other hand, is piece of software that supports one or more APIs by being able to run programs written for those APIs. In most cases, an operating system supports one native API, and then supports other APIs through translation layers.

Windows NT signifies the end of the simple, single Windows API. The 16-bit native API supported by Windows 3.1 is now called *Win16*, and the 32-bit native API supported by Windows NT is called *Win32*. Windows NT also runs most programs written for Win16 through a *translation layer*, which converts 16-bit function calls from the program to the 32-bit functions implemented in the operating system.

Win32 is much more than just a 32-bit version of Win16. Its many enhancements include preemptive multiprocessing, multithreading, a new file system, extended graphics, connectivity, interprocess communication, Unicode support, and security.

If you don't need Win32 enhancements but would still like to get a performance improvement by creating 32-bit programs that run under Windows 3.1, there is another Windows API just for you. It's called Win32s (the "s" is for "subset").

Win32s is basically a 32-bit version of Win16 without most of the Win32 enhancements. Windows 3.1 runs Win32s programs through a translation layer that converts the 32-bit function calls from the application to the native 16-bit functions implemented in the operating system.

Besides providing this set of features, which we all covet for our next-generation operating system, NT has powerful advanced features, like C2-level security, which satisfies the requirements of government customers. For this reason, initially at least, NT is potentially most useful to two groups of computer users: those who currently use advanced workstations to do high-end, specialized work such as CAD, modeling, or other processing and graphics-intensive tasks, and those who need an application server for critical business applications such as databases.

Some advanced features—such as NT's scalability (the ability to run on a wide range of hardware, including Alpha- and RISC-based processors), built-in networking, high-level security, fault tolerance, performance monitoring and management tools, and its interface to major networking and mainframe standards—make NT a clear case of overkill for most desktop PCs. These features also contribute to NT's hefty resource requirments: a 486 or RISC-based machine, 16MB of RAM, and a large hard disk are recommended.

While NT's feature set has been discussed in excruciating detail in these pages already ("Windows NT: The Power Under the Hood," *PC Magazine*, June 15, 1993), NT's actual performance was anybody's best guess. Now, for the first time, the true story unfolds.

NT TO THE TEST

And the story is a complex one. Because NT is so vast, because it can be used as a desktop client or as a full-powered server, because it can run the new 32-bit apps as well as existing DOS and 16-bit Windows apps, because it can be run on a spectrum of machines including the RISC-based MIPS and Alpha AXP machines—we took a good hard look at its performance on a multitude of tests.

The first and most obvious starting point was an investigation of the new 32-bit world. Since NT applications are still relatively scarce (most were in beta when we conducted our testing, and most vendors were reluctant to be first up at bat), we developed some 32-bit apps of our own. We found that while all 32-bit apps run quickly, certain activities really sizzle on the RISC-based NT machines.

Next, we looked at NT's ability to run existing productivity applications. In these tests, we sampled a popular set of DOS and Windows applications. Early beta testing and early rumors had led us to suspect that NT would run these apps considerably slower than they would run

Our Contributors: ROBIN RASKIN is an executive editor of *PC Magazine*. DAVID GREENFIELD is the senior editor of networking and communications of *PC Magazine*. CHARLES PETZOLD is a contributing editor to *PC Magazine*. RICK AYRE is the technical director in charge of software at PC Magazine Labs. GARY GUNNERSON and DAVID S. LINTHICUM contributed to this story. Testing was done by AMARENDRA SINGH, a technical analyst at PC Magazine Labs. Additional testing was done by MAX SCHIRESON and GENE SHEPPARD, senior project leaders, and RYAN TABIBIAN, a senior technical specialist, at ZD Labs.

Making things even more interesting is the fact that a Win32s executable is a native Windows NT executable. Thus application developers who create Win32s programs to run under Windows 3.1 are, at the same time, creating Windows NT executables (albeit ones that don't take advantage of many NT features).

But wait! There's more: Within the past year, a fourth Windows API called *Win32c* (the "c" is for "common," though at one time it stood for "compatible") has emerged. Win32c will be the native API of a product currently codenamed *Chicago*. In all likelihood, Chicago is probably going to be known as Windows 4.0—a 32-bit version of Windows that runs under DOS.

Win32c is another subset of Win32, but a much larger subset than Win32s. Win32c includes multithreading and many of the graphics enhancements, for example. Indeed, Win32c includes nearly everything in Win32 except for the security enhancements. As with Win32s, Win32c executables are native Windows NT executables.

Sooner or later, almost all Windows developers will want to move their existing programs to a 32-bit API. The most direct route is Win32s. The move from Win16 to Win32s is not exactly a transparent port but it's much simpler than moving a Windows program to the Macintosh platform or even to OS/2 Presentation Manager. Many developers of reasonably large applications have found the basic work to require less than a week. The result is a 32-bit program that achieves the highest possible market penetration by running under both Windows 3.1 and NT. In short, developers can move to Win32s without betting the farm that Windows NT will take off.

Going beyond Win32s to use the additional features of Win32c or Win32 really depends on the application. For example, multithreading is important for programs that spend a long time doing big jobs. But a program that is already always reponsive (MineSweeper comes to mind) does not need multithreading.

With the eventual release of Windows 4.0 (assuming that it is as successful as Windows 3.0 and 3.1), Win32c will emerge as the most popular API. Outside of code created for government contracts that require security features, it is probably the rare application that needs a Win32 feature not supported by Win32c. The one catch is that, for some applications, the 32-bit performance improvement gained by moving from Win16 to Win32s may be offset by the translation layer overhead needed in Windows 3.1 to run Win32s programs. This cannot be accurately predicted yet.

For quick reference, here are the layers and the scorecard: Win32 is a superset of Win32c, which is a superset of Win32s, which is a 32-bit version (and slight superset) of Win16. Windows 3.1 runs Win16 programs directly and Win32s programs through a translation layer. Windows NT runs Win32, Win32s, and Win32c programs directly and Win16 programs through a translation layer. Windows 4.0 will run Win32s and Win32c programs directly and Win16 programs through a translation layer. Got it? □

in their native OS environments. The Virtual DOS Machine, a subsystem of NT, was thought to be slow in translating the API calls. In fact, we discovered that the results depend on the nature of the specific application activity, but, at least on the Intel platform, NT runs existing DOS and 16-bit applications quite well.

Comparisons with OS/2 2.1 flowed like water. We compared NT's 32-bit performance, as well as its ability to run DOS and Windows apps, with OS/2 2.1's performance and found that Windows NT is a worthy competitor on the desktop.

Compared with OS/2 in running DOS and Windows apps, we found Windows NT to be a worthy competitor on the desktop.

Over the past few weeks Microsoft has been strengthening the Unix part of its market message, touting NT as the best Unix-like variant on the market. To test NT against Unix implementations, we used a battery of tests that looked at low-level functions. We discovered that the NT platform—486, Pentium, MIPS, or Alpha—made a difference. Specifically, NT running on a MIPS machine performed on a par with other Unix systems.

THE CLIENT/SERVER WORLD

To test NT in the client/server world, we collaborated with ZD Labs and used ZD Labs' Right Size II on-line transaction processing tests. We also compared NT with NetWare 3.11 and found NT a worthy database server.

To test the benefits of the multiprocessor environment, we timed the execution of the Stanford multiprocessing tests while ZD Labs' NetBench, Version 2.06, was run on 36 clients to simulate workstation load. Dual processors were better than single processors but not twice as good.

All of our desktop tests were run on three computers. We used an NCR System 3360 Panther that contained two 66-MHz Intel Pentium chips for both our single- and dual-processor tests. The machine was configured with a 1GB SCSI hard drive and an ATI mach32 video board with 1MB of memory.

To test MIPS performance, we used a MIPS Magnum PC with a 75-MHz MIPS R4400. It was configured with a 500MB SCSI hard disk and a MIPS VXP video board with 2MB of memory. We tested Alpha performance using a DEC Alpha AXP with a single processor running at 150 MHz. It contained a 500MB SCSI hard disk and a Compaq QVision EISA video board with 1MB of memory. Each computer contained 32MB RAM.

We tested the DEC Alpha with a late beta version of Windows NT. In all likelihood our test results did not do justice to the machine because, as we went to press, Digital was still tuning NT to the Alpha and still revising the compiler we had used to create the benchmark tests. We will revisit this platform when a ma-

ture version of Windows NT is available.

To recap, we tested shipping versions of Windows NT on the Intel and MIPS machines and used a prerelease NT on the Alpha. However, we created all of our native tests with prerelease versions of the processor-specific compilers. The Intel and MIPS versions of the compiler were further along. In fact they were release candidates (vendor-speak for what they *hope* will be shipping code).

We've answered many questions; many still remain. As NT applications begin to appear we can better judge how they will take advantage of NT's power. And as hardware becomes optimized for the NT environment, we should continue to see performance improvement.

Running 32-bit Applications

Windows NT is a 32-bit operating system, which means that you should be able to run your applications "32-bit fast." How fast is that? It's tough to say. One good way to test 32-bit speed would be to run the same application under 16-bit Windows and then under NT, and compare the performance. But none of our mainstream productivity applications are currently available in native Windows NT versions.

Another good way to compare performance would be to run benchmark tests, like our PC Bench and WinBench—but we have no Windows NT native versions of them yet. Instead, PC Magazine Labs, in collaboration with PC Magazine UK Labs, designed a suite of Cross-Platform Portable benchmark tests. This suite is based on the same profiles of computer usage that we used for our DOS and Windows tests. It runs native under DOS, Windows, OS/2, and Windows NT. Like our PC Bench and WinBench tests, the suite includes tests for disk access, graphics performance, and processor speeds.

The NT and OS/2 versions of the tests are 32-bit programs. These tests are also optimized for the target CPU, which means, among other things, that different versions of these tests are specific to Intel

NT Apps: *Great Expectations*

by Charles Petzold

Making the jump from 16-bit Windows to 32-bit Windows NT is an important (and long overdue) transition for the PC industry. Yet, Windows NT is more than just a 32-bit version of Windows. It offers many functional enhancements over Windows that may or may not be fully exploited by NT applications. What will the next few years bring?

First and foremost, programmers will want to take advantage of the multithreading support of Windows NT. This feature allows splitting an application into multiple threads of execution that run concurrently. In short, a program can carry out lengthy background jobs while continuing to be fully responsive to the user.

After a few experiences with well-designed multithreaded applications, users will no longer tolerate hourglass mouse pointers. (The downside is that these applications will provide fewer excuses to take coffee breaks.)

Another no-brainer for future Windows NT applications is exploiting NT's support of Unicode. Unicode is an extension of the ASCII character set that uses 16 bits per character rather than 8; it allows the representation of every character in every written language likely to be used in computer communication (including the logographic characters of Chinese, Japanese, and Korean), as well as some symbol sets.

Unicode is likely to replace ASCII at some indefinite time in the future, and Windows NT is the first major operating system to fully support it. Truly international programming has become a reality.

The enhanced graphics of Windows NT is another matter. Any existing program that is converted to Windows NT gets the 32-bit graphics performance for free. But what of the enhancements to the NT graphics engine?

Many of these enhancements are in the area of "vector" graphics, which is the rendition of images composed of lines and filled areas. To the arsenal of vector graphics functions currently in Windows 3.1, Windows NT adds Bezier splines (complex curves used in design work), matrix transforms (used to scale, skew, and rotate images), and PostScript-like paths (used to create arbitrary complex outlines using various line ends and joins).

However, in the past few years, vector graphics has become a specialized area, mostly relegated to CAD. Two of the big names in Windows vector graphics—Corel and Micrografx—have been doing matrix transforms and Bezier splines for years. It's uncertain whether these companies will forfeit their own techniques for the built-in Windows NT support.

While vector graphics has faded to the background of specialized apps, "raster" graphics—the capture, storage, manipulation, and rendition of real-world images based on bitmaps—has come to the forefront, particularly in mulitmedia applications. Windows NT now supports bitmap rotation and masking (allowing the display of non-rectangular images), but again, these have become common techniques that don't necessarily require operating system support. More useful graphics enhancements—such as built-in bitmap compression and decompression, and device-independent color—are still slated for future versions of the operating system.

Corporate developers will probably be less concerned about Unicode and graphics but are likely to drool over other features of Windows NT. (You won't doubt for a minute that Windows NT is an operating system for the corporate environment the first time it gives

chips (with optimizations for Pentium as well as for *x*86), and to the MIPS and DEC Alpha processors.

Our tests revealed two main points. First, the MIPS machine is fast: It's faster than the NCR Pentium on all three of the tests in the Portable Benchmark Suite. Second, on the processor test, OS/2 held its own against Windows NT, though that may say more about the OS/2 compiler than about the operating system.

One anomaly in these test results is the poor disk performance of OS/2. Though NT's numbers are clearly better, we believe the difference can be explained by NT's use of dynamic disk cache. NT allocates disk cache according to system usage and available resources. Some may argue that comparing OS/2's static cache to NT's dynamic cache is not fair, but we believe that these performance numbers do, in fact, reflect real benefits to users.

MIPS was a clear winner on our video tests. Given that MIPS is owned by Silicon Graphics, a company with considerable experience in the area of video and graphics, the MIPS' fast performance comes as no surprise. But the fact that the Alpha did perform well on our video tests was a bit of a surprise, if only because its QVision card is not usually a winner on our 16-bit video board tests. OS/2 appears to score well in graphics, but note that we could get OS/2 to run only in VGA mode, while the NT tests were run at 1,024 by 768 by 256.

The floating-point tests yielded a mixed bag of results. Again, overall, the MIPS running NT seems to be a winner. The Fourier and linear transforms best exhibit the trends we would expect from these tests. They show that on the same processors, OS/2 and NT run at about the same speed. NT's performance on the MIPS machine is better; on the Alpha, it is even better still. Perhaps in this test we are finally seeing the DEC Alpha, which was still in late beta testing when we went to print, living up to its potential. Clearly, as the NT version of Alpha matures, its performance on our tests will improve.

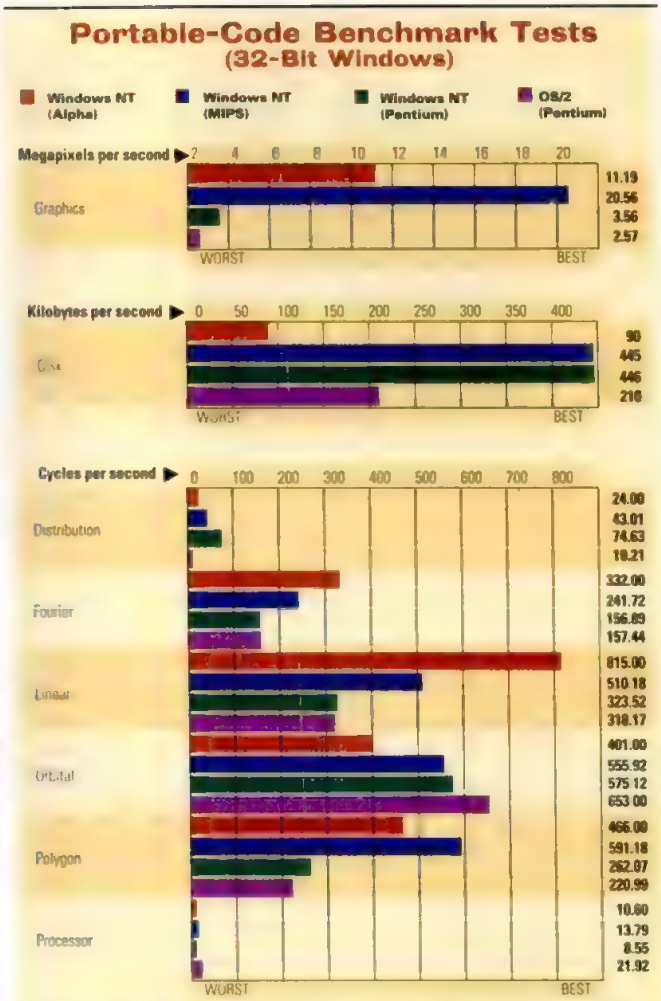
Bottom line: OS/2 2.1 is competitive with NT. Windows NT does scale to the processors it runs on, as demonstrated by good MIPS performance.

you a message that your password is about to expire!) Here, the connectivity and interprocess communication (IPC) features of Windows NT are the main treats.

Windows NT supports traditional forms of interprocess communication such as pipes (a two-way communication system in which programs can pass information back and forth) and mail slots (a one-way communication system in which one program can leave data for another). And yes, these facilities are network aware and, indeed, are intended for networks.

In addition, Windows NT also supports remote procedure calls (RPC), in which applications can trigger one another across a network into performing operations. Another NT feature is network-DDE, a networked version of dynamic data exchange, an IPC system based on the messaging mechanism of Windows.

An operating system such as Windows NT provides both opportunities and challenges for the application developer. At present, accurate predictions are impossible. For example, who could have guessed ten years ago that an obscure DOS function call named "terminate and stay resident" would have spawned a whole slew of new applications called "popups"? Similarly, the real riches of Windows NT are yet to be discovered. □



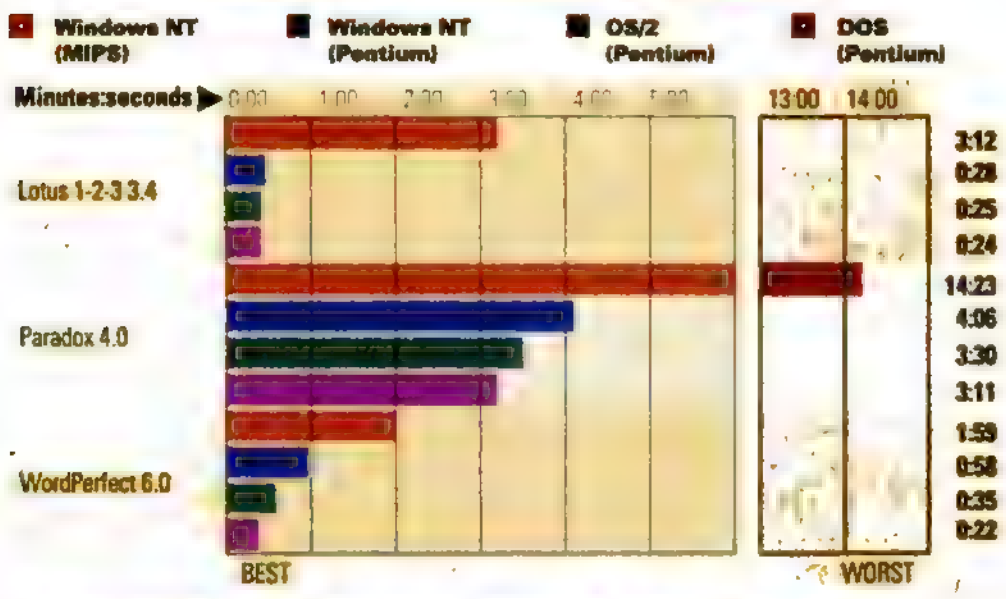
We recompiled these tests for each processor using processor-specific optimizations. Here are the results of the graphics, disk, and processor tests, as well as the results of five floating-point tests.

Working with DOS And Windows Applications

Until some native 32-bit versions of your favorite word processors or spreadsheets exist, you can bet that your current suite of productivity applications will need to move along to NT with you.

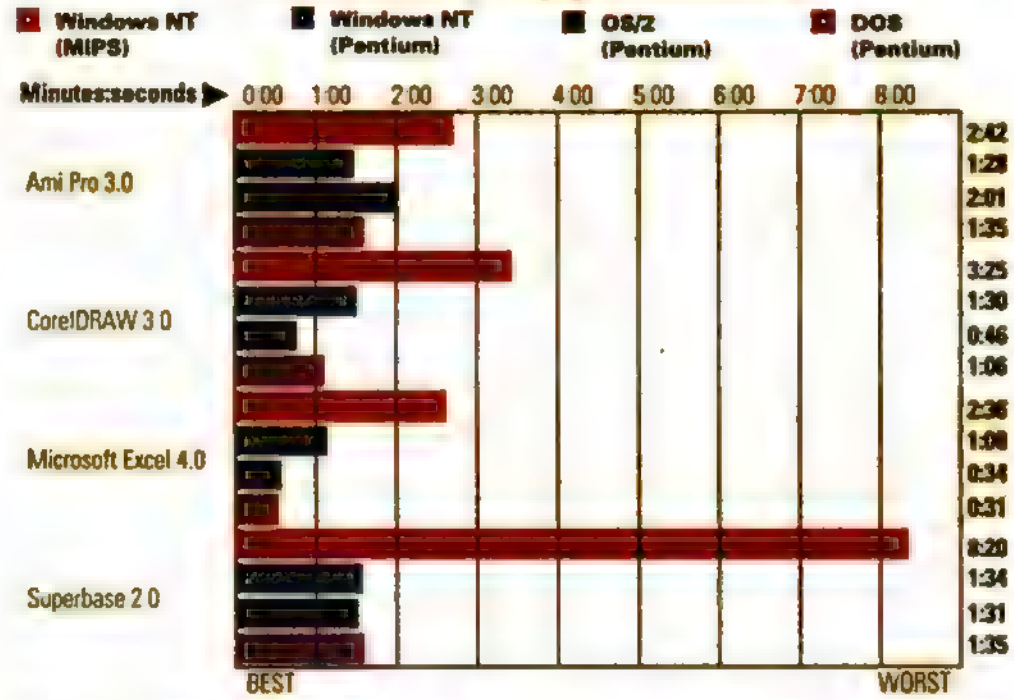
In order to gauge how these applications will fare under NT, we looked at a set of popular DOS and Windows 3.1 applications running under NT. We chose WordPerfect 6, Lotus 1-2-3 Release 3.4, and Paradox 4.0 as our DOS applications; Excel 4, Ami Pro 3, Superbase 2, and CorelDRAW 3 served as our Windows

DOS Benchmark Tests



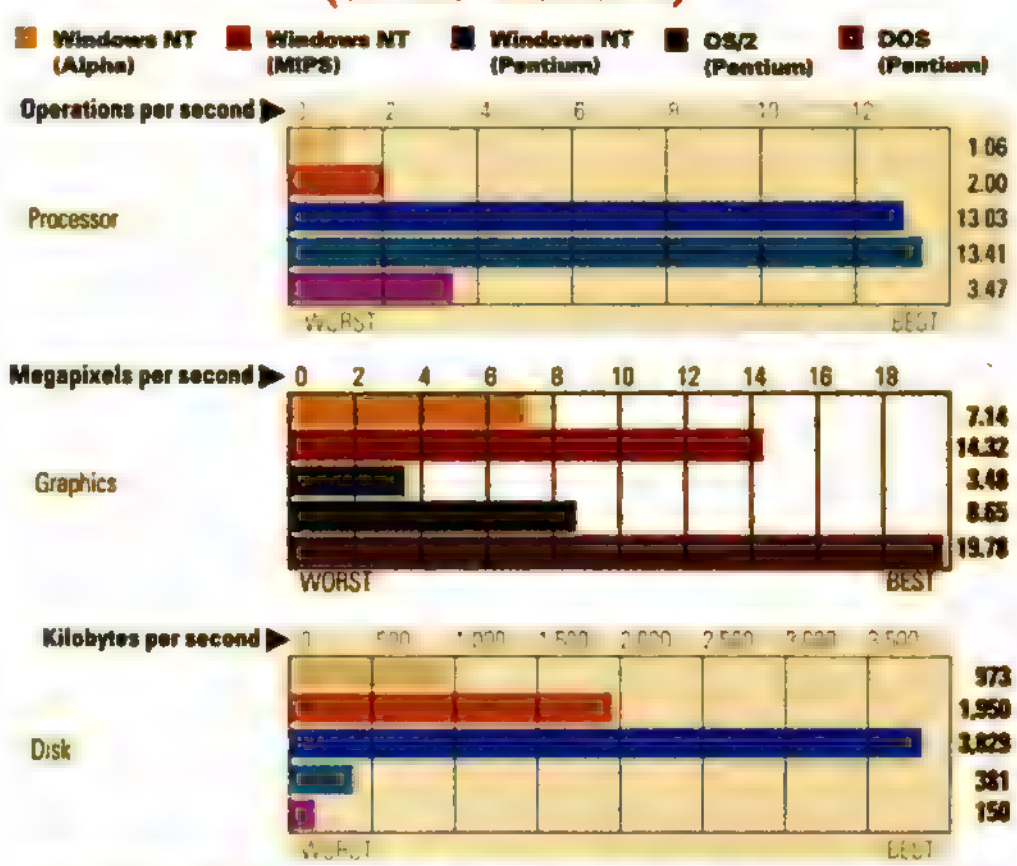
We ran a suite of DOS apps under Windows NT, OS/2 2.1, and DOS 6.0. The Alpha's emulation mode was not available for testing.

Windows Applications



We ran a suite of popular 16-bit Windows applications under Windows NT (on both MIPS and Pentium platforms), OS/2 2.1, and DOS/Windows.

Portable-Code Benchmark Tests (16-Bit Windows)



These tests were compiled as Windows 3.1 apps and run using the 16-bit Windows emulation built into NT running on Alpha, MIPS, and Pentium chips.

applications. Each of these applications performed a series of macro-driven tasks except for CorelDRAW, which used DDE to execute the commands.

We selected applications tasks that would mirror the application profiles of everyday, mainstream productivity applications. The Windows tests are the same Windows Applications tests described recently in our reviews of portable PCs (see "Power Without the Pounds," *PC Magazine*, August 1993) and in our recent utility software roundup (see "DOS 6 vs. the Competition: What's the Price of a Free Lunch?" September 14, 1993). The DOS tests were developed after the Windows tests and closely approximate the Windows Application test suite.

DOS applications are fastest under DOS, almost as fast under OS/2 2.1, and only slightly slower under Windows NT running on a Pentium-based system.

Testing DOS and Windows applications was, in many ways, the simplest and most straightforward part of all our NT testing.

Our DOS applications tests proved that our initial hunch about running DOS applications under Windows, Windows NT, and OS/2 was correct. DOS apps are fastest under DOS, almost as fast under OS/2 2.1, and only slightly slower under Windows NT running on a Pentium. On a MIPS, DOS applications began to slow considerably. NT runs DOS apps slightly slower than OS/2 on the Pentium because of the added security the operating system offers. But NT is significantly slower on the MIPS machine because the MIPS translation layer must cover not only the DOS API as it does on the Intel platform but translate the processor calls as well.

The Windows Applications test results are more complicated to interpert because the scores depend on the type of activity the application is performing. The spreadsheet performance (mostly recalcs, with some worksheet formatting) and database performance met all of our expectations, with Windows apps running fastest on their native platform.

On the graphics drawing tests, OS/2 beat both Windows and Windows NT on all platforms. The reason is that OS/2 was running in VGA mode, while the other systems were running in 1,024-by-768-by-256 mode. Since OS/2 2.1 would not run reliably with the ATI video drivers, we had to use standard VGA drivers.

One eyebrow-raiser that showed up in the word-processing test was that Windows NT ran faster than Windows itself. This result can be explained by the unique way Ami Pro spins off its printing to a built-in background process. It is important to note that the printing did not complete any faster, but Ami Pro under NT did return control to the user faster.

Bottom line: If you want to run only DOS and Windows applications, then OS/2 is faster than Windows NT. If, on

Advanced Server: *How It Fits*

by Gary Gunnerson and David Greenfield

The way Microsoft tells it, if you want to move beyond Windows, you'll look to Windows NT; if you want to move away from Novell, you'll turn to NT Advanced Server. The promise of NT Advanced Server is enterprise-strength networking on the NT platform, using the highly graphical Windows interface. We found the product quite powerful, but noted a few shortcomings and inconsistencies in this first version.

Advanced Server's facilities fall into four broad categories: network management and administration, security and logon control, reliability, and client support. Significantly, Advanced Server introduces the concept of domains to the the Windows environment. A *domain* is a group of servers. Under NT (and under NetWare 3.1), each server is managed separately. Under Advanced Server, several servers can be grouped as a domain and managed from a single PC. This centralization allows user profile configurations to be stored in one location, enabling users to log into the network from any domain.

The software also offers some key enterprise features. Advanced Server increases system reliability through its support for RAID (redundant array of inexpensive disks): Both RAID 1, which mirrors data from one drive to another, and RAID 5, which increaes performance and reliability by spreading data across an array of disks and protects that data with a parity check. In contrast, Windows NT supports only Raid 0, which stripes data across an array without parity checking.

Advanced Server makes it easer to configure clients through directory replication, a feature originally offered in Microsoft's OS/2-based LAN Manager. This feature lets a server automatically load files from a particular server directory into designated clients. Remote users are supported through Remote Access Services (RAS). These services are expanded from a single user in NT to as many as 64 users in Advanced Server.

NT supports DOS, Windows, Unix and OS/2 clients. Advanced Server adds Macintosh support. Acccessing a volume from a Mac follows Macintosh conventions (you mount a volume and it appears on the Mac destkop; Advanced Server also lets Macs print to non-PostScript printers. Sometimes, though, basic Mac functions, such as how to unlock a Mac volume, are not included in the Microsoft documentation.

Appletalk, the Macintosh network protocol, is the only protocol that Advanced Server can route. Novell's IPX, IP, or NetBEUI cannot be bridged or routed by NT. We expect third-party vendors to fill the gap.

Unix support, which is for character-mode, POSIX-compliant apps only and built into NT rather than Advanced Server, could be stronger. Network managers want an advanced file system like SUN's PC-NFS or Microsoft's Server Message Block (SMB) implentation of Advanced Server running on the client. With NT, Unix can only move files through and from the NT server through the file transfer protocol (FTP). They cannot print or read a file on an NT server. NT clients can send and receive files on a Unix server via FTP or log on to a Unix server via Telnet.

One of the unanswered questions is how well Advanced Server will run NetWare clients. Microsoft built NetWare network and transport protocols (IPX/SPX) inside Advanced Server. Developers can write client-server applications that can communicate directly with NetWare clients. While Advanced Server's NWlink worked well on a single network adapter running a variety of protocols, the instant we added a second adapter, we experienced problems. Also, the Novell requestor, which will be available from Novell, was unavailable during our testing.

The Windows interface should make Advanced Server consistent and approachable. In fact, installation and configuration were a snap. However, changes to the server, like adding a protocol, could be implemented only by rebooting the server. In addition, the deluge of icons and the highly hierarchical structure of Advanced Server has its inconsistencies. For example, both Mac and Unix volumes are listed under the control panel's Unix and MAC icons, but only Unix volumes can be controlled from the Control Panel. You need to click a separate icon to control Mac volumes.

Advanced Server is priced attractively. A 50-user license costs $1,495, $3,000 less than NetWare 3.11. Network administrators who need to connect PCs and Macs, or just Macs, may find Advanced Server a reasonable choice at a reasonable price. Windows for Workgroups users will benefit from its close integration with Windows NT; it is doubtful that they'll need Advanced Server's enterprise-strength facilities.

If you run NetWare, there's no compelling reason to switch to Advanced Server just for file- and printer-sharing services. But Advanced Server, in tandem with NetWare, could be a powerful applications server. This depends on getting multiple adapters to function and getting Novell's Requestor.

Advanced Server's strengths are its good Macintosh services, approachable graphical interface, potential as an applications server, and low price. It also incorporates the inherent benefits of Windows NT. Hopefully our concerns about Unix services, NetWare client support, and inconsistencies in the interface will be addressed. □

the other hand, you have a Windows NT application you want to run, you can be confident that DOS and Windows applications will run acceptably under NT.

Applications Integration

Running an individual Windows application is not nearly as rewarding as running multiple applications. With Windows NT you can have multiple applications running (through its multitasking feature), and also have each application split into multiple tasks (called multithreading). This eliminates the dreaded hourglass when you're doing things such as recalculating or printing. Instead you'll regain control of your application almost immediately.

The ability to run multiple applications becomes more powerful with the use of three common features of Windows operating systems: the Clipboard, DDE (Dynamic Data Exchange, and OLE (Object Linking and Embedding).

How well does Windows NT preserve the capabilities that already exist in Windows 3.1? How well does it transcend these capabilities? How well will NT handle integration between existing Windows 3.1 apps and the new 32-bit applications that are forthcoming?

In general, the application integration features perform much the same under NT as they do under Windows 3.1.

To test DDE links, we created a DDE link between an Excel 4.0 spreadsheet and an Ami Pro 3.0 document. Both applications are Windows 3.1 applications. Once we created the link we updated and closed the Excel spreadsheet. When we reopened the Ami Pro document, it automatically launched Excel, extracted the data, and refreshed the document.

To test the current OLE 1.0 capabilities of Windows, we inserted a new object (a Paintbrush file created using the new Windows NT Paintbrush) into an Ami Pro 3.0 document. Double-clicking on the Paint object within the Ami Pro document launched us into Paintbrush. All worked as expected. Windows NT supports OLE 2.0, but none of the current applications are OLE 2.0 enabled. OLE 2.0 will allow in-situ editing, which means you can click on an embedded object and gain access to context-sensitive menus.

Note that test applications, Excel and Ami Pro, are Windows 3.1 applications; they worked in a single virtual machine. The VM insures complete compatibility with the Windows 3.1 environment, including support of the Windows Clipboard, DDE, and OLE. The downside is that if one of the Windows 3.1 applications crashes, the entire virtual machine is in jeopardy of crashing. However, in our tests, even when we crashed the Windows 3.1 virtual machine, the NT operating system itself—and other DOS or NT applications—did not crash because each runs in its own protected space.

In NT, as in Windows 3.1, Object Linking and Embedding only works on a single machine, not under a network.

As in Windows for Workgroups, NT uses Network DDE, which allows applications to exchange information across a network. We tested Network DDE by creating a Paintbrush image on an Intel-based machine, which we copied to the Clipboard. We then shared the Clipboard file over the network. Not only did this work well, but we were even able to open, edit, and update the image on the MIPS machine.

Like in Windows 3.1, Object Linking and Embedding (OLE) only works on a single machine, not under a network. Microsoft says that for network object management, you'll have to wait for the next major release, code-named Cairo.

Windows NT incorporates all the multimedia accessories of Windows 3.1. It adds video support in the Media Player, as well as an audio CD-ROM player.

A Better Unix Than Unix?

Most people who run Unix on a desktop computer call it a workstation and spend a fortune to do it. Windows NT, if it can deliver performance at an attractive price point, may well be the Unix killer.

Unix workstations have many parameters that require complex performance-tuning. Often the performance required is very specific to the task. To compare Windows NT to various Unix platforms, we compiled a native Windows NT version of the Stanford multiprocessor tests that we used to report on workstation platforms (see "Workstation Platforms: Heavyweight Contenders" *PC Magazine*, June 15, 1993).

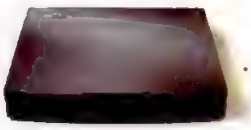
The Stanford test routines characterize multiprocessing capability, which in this case means multiprocessing on a single CPU. This is often called *threading*. Our charts shown in this issue reprint some of the Unix data gathered from the earlier issue (June 15, 1993) where we tested new PC platforms. This data is compared against new data gathered on the NCR 3360 Pentium and the Magnum MIPS R4000. The tests, once again, were compiled with processor-specific optimizations.

The chart components shown here report on three important aspects of workstation performance. The floating-point test suite includes fast Fourier transforms and floating-point matrix multiply. These routines are used in three-dimensional transformations, two-dimensional image enhancement, and image scanning. The integer test suite includes a bubble sort, a matrix multiply of integer arrays, and a compute-bound algorithm of many nested loops. Integer math is typically used by Windows NT in its graphics computations. The recursion test suite performs numeric compares on simple data structures, with almost no math. Together the tests comprise the Stanford test suite and offer a good look at some of the low-level processes involved in the OS. The Stanford tests were run sequentially. Each test started as a single process then spawned its own threads.

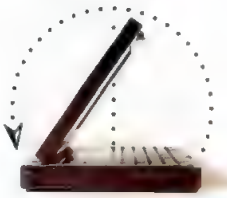
On the Stanford test suite, Windows NT running on a MIPS was a big winner. While NT performed very well in general, the MIPS' performance was outstanding. The MIPS outperformed workstations that cost a great deal more. (The HP, an Apollo 9000, for example, lists for

It sits,
lies down,
and does
back
flips.

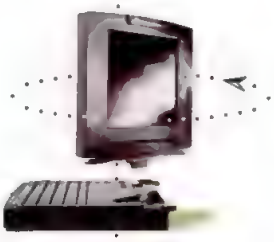
Good b



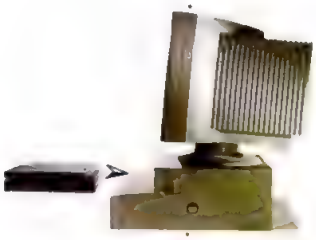
The most flexible screen



It opens flat up to 180°



Or flips around in just seconds



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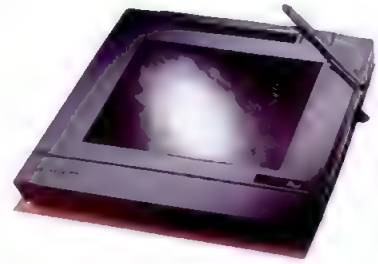

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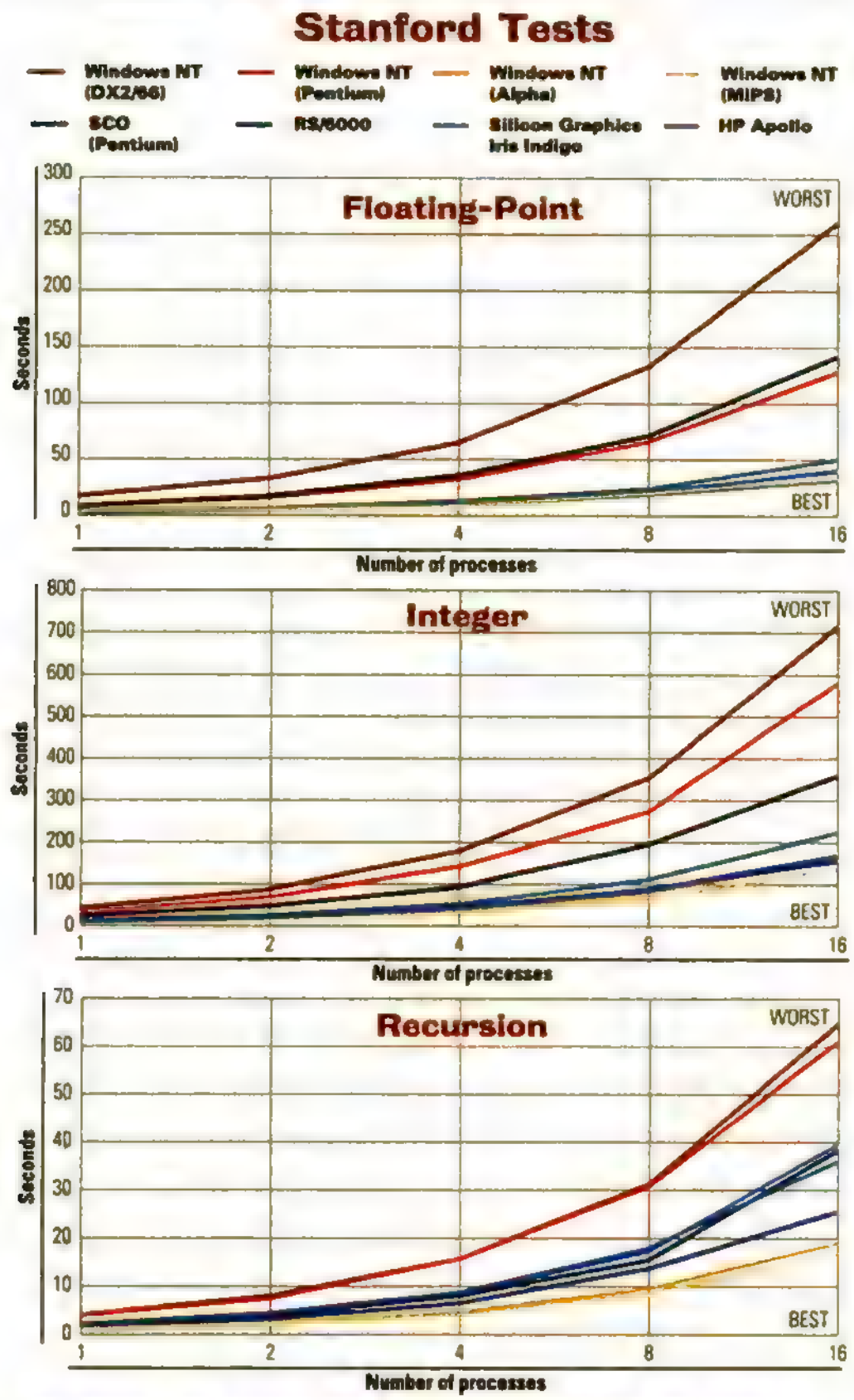
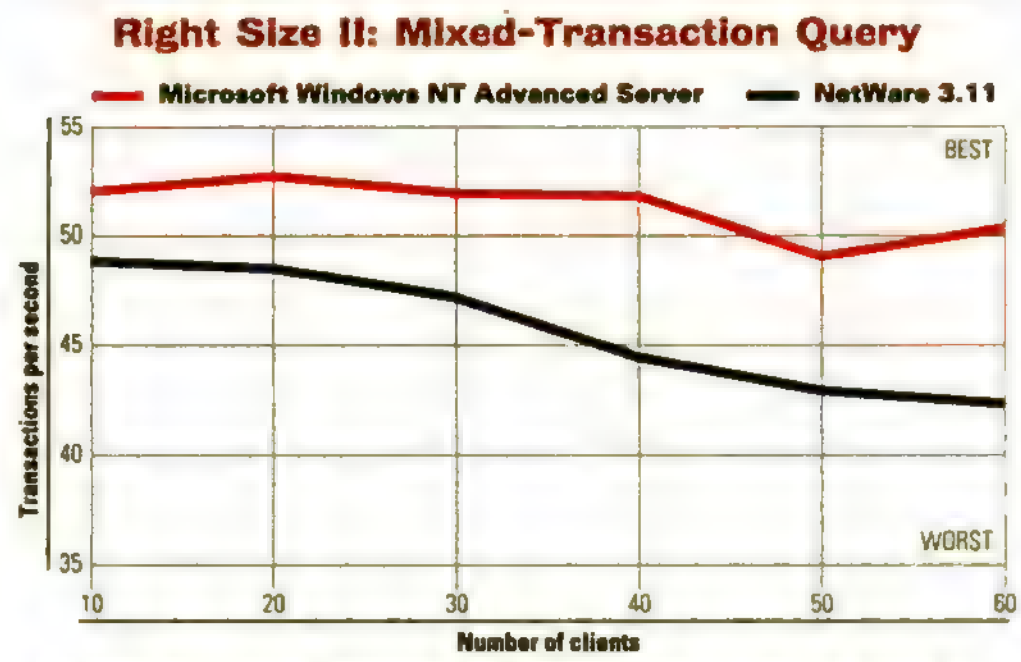


The Stanford Tests measure multiprocessing capability. Each routine is run as a single process, and then sequentially, with 2, 4, 8, and 16 processes. The tests were run on an NT system and several Unix systems. (Some Unix results may not be visible, as the scores are tightly clustered.)



The Right Size II tests Microsoft SQL Server running under Windows NT Advanced Server and Sybase SQL Server running under NetWare 3.11. As clients were added, the performance gap between NT Advanced Server and NetWare widened; NT Advanced Server was the better of the two.

$17,400. The IBM we tested, the IBM RS/6000 PowerStation 365, lists for $23,435. The MIPS Magnum, configured as tested, has an estimated price of $9,000.)

As for running actual Unix apps, Windows NT could be improved. NT runs POSIX-compliant Unix apps in character-mode only. This, one could argue, precludes the possibility of NT replacing Unix on the desktop, at least not quickly.

Remember, too, that UNIX has always excelled in its networking capabilities. The latest iterations of the popular Unix variants typically have robust network administration tools, remote access, and multiprocessing tools built into the operating system. Some Unix systems handle multiserver configurations. NT provides some networking capability (support for a single server and single departmental access rights), but users will need to add Windows NT Advanced Server to the relatively inexpensive but additional power of full multiserver support, cross-departmental access rights, Macintosh services and full remote access services.

The bottom line: NT performs very well on the Stanford test suite, so it may be an attractive target for Unix developers who want to reach a wider audience.

NT: The Applications Server

Microsoft emphasizes the benefits of using NT as an applications server. According to Microsoft, NetWare suffices as a file and print server, but client/server applications demand a different architecture—one that Windows NT provides.

One of the most popular applications to run on a network server is the database server. For that reason we chose to test NetWare against Windows NT as a database server. To do this we chose to look at Sybase SQL Server, available as an NLM, and Microsoft SQL Server, which will be available for NT momentarily.

We tested the applications server aspects of NT at ZD Labs using the ZD Labs' Right Size II on-line transaction processing benchmark tests. Since the test suite was originally designed using the Sybase SQL engine, we used Sybase SQL Server 4.2 running under NetWare 3.11 to perform the tests. Then we ran the test again using a late beta of Microsoft SQL Server 4.2 running under Windows NT Advanced Server.

The test suite used a 1.4GB database that consisted of two tables: product and parts. We ran three types of transactions: cached query, standard query, and update. Next we ran a mixture of the three that we report as our "mixed transaction query." The cached query submits a query for ten rows of data. The standard query submits a much more complicated request that uses a join operation to link ten rows from the product table to 40 rows in the parts table. The update test makes each client update ten rows in the product table. Finally, the mixed query combines all three tests using a 5:1 read operations to write operations ratio. In order to provide one score for the mixed query, we weighted the three queries so that the cached query and the standard query each contributed 9 percent to the

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Is NT Crash-Proof?

by David S. Linthicum

A major advantage of using an operating system like Windows NT is the reliability of the environment. As users bring ill-behaved DOS and Windows applications to NT, this reliability will be put to the test.

With NT, as with OS/2 and some versions of Unix, each application runs in a separate space, called a virtual machine (VM). A VM is a computer that does not physically exist but is simulated by the operating system. One benefit of running an application under a VM is reliability. If the application crashes, the crash, in theory, is confined to the VM and does not affect other applications that are running.

To ascertain NT's reliability we put it through a series of torture tests, just to see if it could be locked up, rebooted, or terminated. Our experiments could rightly be called nasty and destructive. They included working with Windows, Windows NT, and DOS applications. We tested memory-access violation routines, floating-point and integer divide-by-zero attempts, illegal and privileged instructions, improper BIOS calls, I/O port access violations, and paging infringements. We also ran several DOS and Windows applications that were purposely buggy. All tests were performed on a 486/DX2-66 with 16MB of RAM.

CRASH PROTECTION: THEORY

Most of you are probably pretty good at getting Windows to crash or lock up. The developers amongst you know that one false move into the wrong area of memory, or one integer overflow violation—and it's all over. Windows 3.1 is better than earlier Windows, but is it crash-proof? Nah.

Why does Windows crash? Because Windows 3.1 executes all applications in the same VM. They are not protected from each other. If one Windows application crashes, others that are runnning will likely follow.

If Windows applications are executing under NT and crash occurs, NT terminates the VM in which the application is running *before* it can affect other NT processes or the operating system kernel itself. Because the virtual memory manager provides a private address space for each process and, more importantly, protects the processes from each other, in theory NT keeps running even when applications crash.

CRASH PROTECTION: THE REALITY

Rude Windows applications won't be protected one from another however. Since all 16-bit Windows applications are run under NT in a single virtual machine, Windows run under NT is bulletproof compatible. This means that, just like Windows 3.1, even if just one Windows application causes a severe problem, the entire NT Windows 3.1 subsystem will crash.

Our tests were able to demonstrate Windows subsystem crashes. Still, while the Windows 3.1 subsystem crashed, the NT kernel never skipped a beat. We could not get it to lock, to reboot, or to terminate.

DOS applications fare better still. They maintain their own virtual space in the operating system. If they cause a severe problem they are simply terminated by NT. Our tests included several intentionally disruptive DOS applications that we invoked from the NT "DOS-like" prompt. They all caused General Protection Faults. One even gave NT a 10-second spasm, but none adversely affected the operating system or other active DOS, NT, or Windows applications.

What we really tested is what is referred to as the structured exception-handling of Windows NT. Exception handling is like a premarital agreement: It provides the details of how a system should respond if things don't go as planned. An exception handler, built into the operating system, waits for something unexpected to happen, then, based on what did happen, takes over and issues a series of instructions to the system that allow it to recover gracefully.

If an application uses an illegal memory reference, for example, the exception handler might stop the application and reply to the application in detail about the errror in its ways. We noticed that NT can take its time when checking out an application before it coughs up an exception error. For example, we timed one application, which tried to overwrite memory that didn't belong to it, at 10 seconds from execution to exception.

It's possible, we suppose, that developers will, in their own creative ways, find one that will get under the skin of NT, but for now, it's nice to find an operating system with a heart of steel. □

final number and the update test contributed 82 percent.

We ran all these tests on a Compaq ProSignia server with 32MB of memory and four 550MB SCSI hard disks on an internal disk controller. Disk striping was enabled in software. Our workstation load consisted of 60 clients, loaded in 10-client increments. Though we ran all the test queries individually, we report just the results of the mixed transaction query in our table.

The numbers look very good for NT. Overall, NT is faster than NetWare, and the difference between them grows as clients are added. Initially, with 10 clients, we saw a difference of about 6 percent. This grew to a difference of about 19 percent as worktsations were added.

What is not evident from our table is how the individual queries contribute to the mixed query score. To summarize the individual scores: MS SQL Server did better on the standard query, which is a larger one. Sybase SQL Server performed better on the cached, smaller, query. The differences were dramatic.

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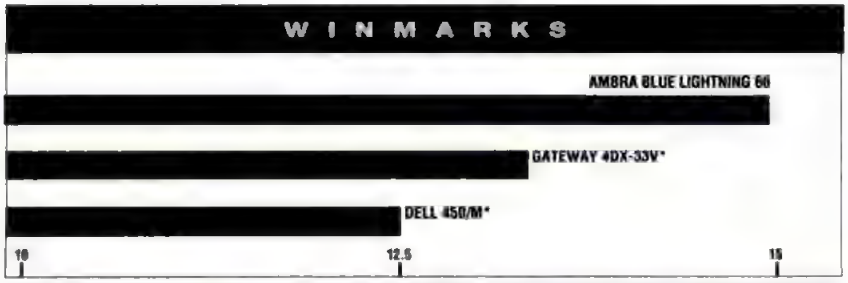

*Results measured in millions of Winmarks™ Reported in *Window Sources* (Ziff Davis), June 1993. Call AMBRA for specifics of this graphics Winmarks test.

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On our standard query test, for example, NT reported more than twice the transactions per second as NetWare. Using a 60-workstation load, NT reported 9.49 transactions per second, while NetWare reported only 3.78. NetWare, on the other hand, did very well on the cached query tests, and—something we know from earlier tests—very likely would have done better overall if hardware striping had been used instead of software striping.

In general, NT does well with some kinds of transaction processing while NetWare does well at others. That in itself is no great revelation. In context, though, there is meaning. In the past, NLM versions of SQL databases consistently outperformed all comers (LanMan, for instance). As a database server, Windows NT is a challenger to be reckoned with.

The bottom line: Windows NT Advanced Server performed well enough on our Right Size testing to merit serious consideration, at least as a database applications server.

The Scalability of Windows NT

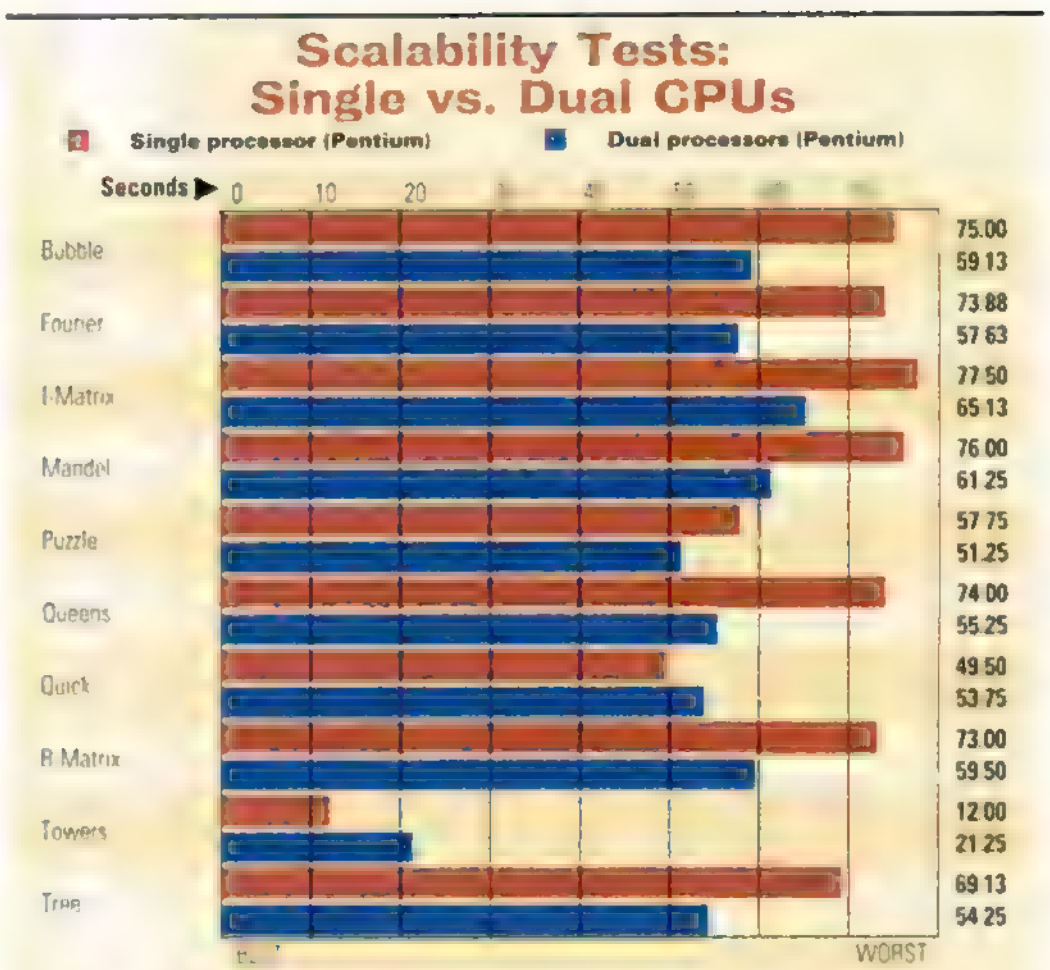
Scalability means different things to different people. For one thing, it means that you can run NT on a variety of hardware platforms. And that you can't outgrow NT because you can add hardware as necessary.

One example of scalabilty is NT's support for symmetrical multiprocessing, or SMP, which is included as a part of the NT Operating System. The only other OS that runs on the Intel platform and can make the same SMP claim is SCO Unix.

To test the efficacy of SMP support under NT we ran the same Stanford tests decribed in the earlier section "A Better Unix than Unix?". This time, though, we ran the processes *and* the tests concurrently instead of sequentially, as we did earlier. That is to say, the Stanford tests were launched running eight processes concurrently, with each process performing multiple tasks on different threads. Also, this time we ran ZD Labs' NetBench, Version 2.06, as a background process from 36 clients, each attached to the NT server and each performing read and write operations in different block sizes to a 1MB file.

The tests were run on our NCR 3360 Panther dual Pentium, which had a 1GB SCSI hard disk, 32MB of RAM memory, and an ATI mach32 video board with 1MB of RAM.

First we configured the NCR 3360 Panther to run with a single processor, then we reconfigured the same system to run with dual processors. Instead of summarizing the three types of tests as we did earlier, our chart presents the comparisons for each individual portion of the ten-component Stanford test suite.



Here the Stanford Tests were run concurrently, as opposed to sequentially. They were run with NetBench 2.06 executing as a background process, allowing us to determine the benefits of multiple CPUs.

The results confirm Microsoft's claims for NT SMP support, but many users may be surprised that the gain is nowhere near the doubling of performance that one might expect from the addition of a second processor. Two of the tests actually ran slower with two processors; eight tests ran faster. The tests ran from 12 percent to 33 percent faster on dual processors than they did on a single processor.

Scalability means you can run NT on a variety of hardware platforms, and you can't outgrow it because you can keep adding hardware.

Some of the reasons for the lower-than-anticipated performance can be attributed to the fact that the tests we ran taxed the disk system heavily. This disk-taxing is not unlike high-volume network loading, but it does affect how much improvement a second processor can achieve. We believe that less disk-intensive applications may well be capable of more improvement with dual processors than the 33 percent we report.

Bottom line: These tests demonstrated the scalability of Windows NT—the ability to use multiple processors to enhance performance. The results also indicate that users may well want to examine SMP from a cost-benefit perspective, as well as from an absolute benefit perspective, before investing. We will continue to investigate with more rigorous testing. □

▶ FACT FILE

Microsoft Windows NT
Microsoft Windows NT, Advanced Server
Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 206-882-8060.
List price: *NT, $495; NT Advanced Server, $1,495 per server.*
Requirements: *80386-/80486-based PC, 8MB of RAM (12MB recommended, 16MB recommended for SDK).*
Circle 494 on reader service card
Features Plus: *From September 20 to 24, you can go on-line on ZiffNet's Executives' Online Forum to discuss Windows NT with* PC Magazine*'s Robin Raskin and Rick Ayre and Microsoft's Rich Tong. Just type GO ZNT:EXEC from any CompuServe prompt.*

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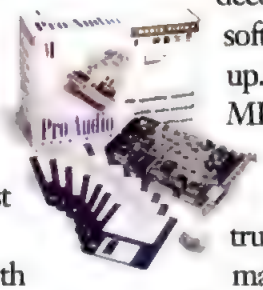

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BASIC COMPILERS & INTERPRETERS

Not So BASIC Anymore

By Sheryl Canter

Lost your BASIC instincts? Then it's time for a reassessment. State-of-the-art compilers, powerful syntax, and visual development environments make today's BASIC a serious development tool.

BASIC, shorthand for Beginner's All-purpose Symbolic Instruction Code, is definitely not just for beginners. Created in the 1960s as a teaching tool by Dartmouth professors John Kemeny and Thomas Kurtz, BASIC was an accessible and ubiquitous PC adjunct (BASIC has been shipped with DOS since Version 1.0). Over time, it has grown to be much more: a highly developed language with all the features needed for professional use. Some of BASIC's newfound strength comes from conceptual enhancements such as syntax extensions and support for structured programming. But much comes from pure added horsepower: robust integrated development environments (IDEs), optimized compilers with support for multiple CPU/ floating point units, sophisticated debugging tools, and toolbox libraries supporting

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Photograph by Dennis Potokar

everything from user-interface design to database file handling.

Yet BASIC remains relatively easy to use and its syntax remains highly readable and English-like. If the program variables are clearly named, even inexperienced programmers should have no trouble following a program's logic. BASIC also still packs heavy functionality into high-level statements while shielding the programmer from many complexities. Most of the BASIC dialects reviewed here offer the ease of interpreted execution from within the IDE to supplement their compilers. This feature lets you run code on the fly without stopping to compile, sometimes even letting you continue execution after changing a variable or instruction.

STRUCTURAL SUPPORT

One of the big barriers to professional acceptance fell when BASIC adopted structured programming constructs. The original BASIC did not even have a multiline if-then-else statement; it instead relied on line numbers with GOTO and GOSUB commands. The result: Most BASIC programs were rat's nests of twisting logic—what programmers disparagingly refer to as spaghetti code. Older versions of BASIC also had no concept of local variables, and when everything is global, large applications can become complicated and bloated. Programming purists felt that BASIC corrupted the minds of budding programmers by encouraging bad habits. Many universities switched to Pascal, a language that was also originally developed as a teaching tool (see "Pascal: How Does It Compare?").

All of this has changed. With the introduction of BASIC language statements such as SUB, FUNCTION, and PROCEDURE, combined with the ability to pass variables, you became able to structure your program using subroutines and functions. This approach aids program design, makes debugging easier, increases readability, and lets you reuse proven code. Another aid to structured programming is the ability to control the scope of a variable; you can make it global or make it local to a subroutine or function. Modern BASIC also requires no line numbers and lets you optionally require variable declarations. The demand for visually oriented interfaces that respond to mouse clicks and hotkeys has led to another new twist: development environments that support event-driven programming as well as the older procedural model. Among the reviewed packages, Microsoft Visual Basic for Windows, Microsoft Visual Basic for DOS, and GFA-BASIC for Windows fit this category.

Programming purists felt that BASIC corrupted the minds of budding programmers by encouraging bad habits.

MANY FLAVORS

Of course, it's misleading to talk about BASIC as an entity. There is an ANSI standard for BASIC, but unlike with C and other languages, there isn't much emphasis in the BASIC world on compliance. In fact, the core of common commands is relatively small.

There have been a number of de facto standards over the years. The first were Microsoft's BASICA (which was written under subcontract to IBM, and shipped with older versions of IBM's PC-DOS) and GW-BASIC (which shipped with Microsoft DOS prior to Version 5). Microsoft's QuickBASIC, which took the BASIC world by storm, was not 100 percent compatible with some of the older products, but its great popularity quickly defined a new standard. Microsoft's Professional Development System (PDS) is an enhanced version of QuickBASIC. Microsoft's QBasic, which is a version of QuickBASIC without the compiler, is now bundled with both PC-DOS and MS-DOS.

But even Microsoft doesn't take QuickBASIC compatibility too seriously. Visual Basic for Windows, its current BASIC flagship, doesn't support the complete QuickBASIC command set. Seldom does a BASIC program written for one vendor's product work unmodified with another's. In fact, none of the BASIC products reviewed here was able to run *PC Magazine*'s performance test code without some degree of massaging.

This fact of life has several implications. You not only need to examine which BASIC offers the best command set for your tasks, but you need to investigate the relative ease with which you will be able to convert legacy code. You'll also need to consider which, if

Suitability to Task: BASIC Compilers

Given that all of the reviewed BASIC packages position themselves as professional development systems, suitability for overall professional development was the central focus of our story.

The rating in **professional development** is the sum of many evaluations. We began by comparing the relative strengths of the language syntax itself and then tested the power and efficiency of the editor, debugger, and compiler. We looked at each compiler's support for a variety of processors and coprocessors, the size and efficiency of generated code, and the documentation and on-line help provided by each package

Writing those small ad hoc utilities or routines you need in a hurry represents a common but very different use of BASIC language systems from conventional development practice. In **quick development**, we evaluated how useful each package is for this purpose. Here, ease of use is important and interface design tools are paramount.

For the **finance and statistics** score, we evaluated the language features or supplied libraries that support matrix math, statistics, or financial functions used to create business and statistical applications

The score in **business graphics** indicates each BASIC system's suitability for creating business graphs and charts.

SUITABILITY TO TASK

Product Name	POOR	FAIR	GOOD	EXCELLENT
Professional development	●	○	○	○
Quick development	●	●	○	○
Finance and statistics	●	●	●	○
Business graphics	●	●	●	●

any, third-party libraries are compatible with the package you pick.

INDUSTRIAL STRENGTH

BASIC has also been criticized for its slow execution speed, bloated code size, and limited capabilities. None of these objections holds true today. Not all BASIC development systems compile programs to native machine code but, at its best, modern compiled BASIC can be as fast as C or Pascal.

Older BASICs such as GW-BASIC and BASICA were interpreted rather than compiled. Program statements were parsed at runtime, one line at a time. Today, interpreted BASIC has gone the way of the dinosaur, although some implementations compile to pseudocode (p-code), a semiparsed version of the source code that's interpreted at runtime. P-code executes more quickly than interpreted code but is slower than native machine code. BASIC implementations that use p-code also need to supply a p-code interpreter in the form of a DOS runtime module or a Windows dynamic link library (DLL) to run.

All the DOS products we reviewed except True BASIC can create small, standalone, machine-code executables. The only Windows product discussed here with a native-code compiler is GFA-BASIC. The others—CA-Realizer and Visual Basic (VB)—compile to p-code (see "CA Realizer: Cross-Platform Power"). In fact, you cannot use VB by itself to create new VB custom controls; you need an assembler or a C compiler.

Even though most BASIC programming systems don't have the degree of low-level control offered by languages such as C, various BASIC products differ significantly in their low-level power. For example, VB can't produce Windows DLLs, while GFA-BASIC for Windows can. Among the DOS products, PowerBASIC stands out with its user-defined data types that let you assign several variable types to a single named variable. It also supports many more data types than most other dialects of BASIC do and is unique in its ability to specify options for compiling and linking inside the source code. To provide a way to handle program components that BASIC itself can't handle or can't handle well, some dialects of BASIC (such as Microsoft PDS and PowerBASIC) can call assembly language routines. But of the products we reviewed, only PowerBASIC has the ability to include in-line assembler code.

H I G H L I G H T S

BASIC Compilers and Interpreters

IT'S NOT JUST a teaching tool anymore. From its humble beginnings as a language to teach computer programming to novices, BASIC has matured into a powerful development tool suitable for most any professional application.

FORGET ABOUT the tales you've heard about bloated program size, limited capabilities, slow execution speed, and spaghetti code. The developers of BASIC compilers have laid those objections to rest. In terms of executable size and speed, modern compiled BASIC programs can be as efficient as rival C or Pascal applications.

STRUCTURED PROGRAMMING and event-driven programming are largely to thank for breathing new life into the language. Structured programming constructs allow developers to structure programs using subroutines and functions, aiding program design and letting developers reuse proven code. In addition, the demand for visual user interfaces that respond to mouse clicks and hotkeys has led to development tools for Windows and DOS that support event-driven programming as well as the older procedural model.

SLICK IDES in the more advanced packages make developing and debugging programs a snap. Combined with BASIC's relatively straightforward syntax, these IDEs still make BASIC the ideal language for novices to begin with and grow with.

DIFFERING DIALECTS makes switching from one BASIC system to another an ordeal, so examine the language's command set to ensure it's adequate for your needs.

THE EXTRAS

Where BASIC implementations can really shine is in the high-level features added to make even difficult tasks easy. One powerful feature common to most dialects of BASIC is variable-length strings, which can grow and shrink as needed without programmer intervention. Most BASIC dialects also add myriad other specialized high-level functions including graphics, animation, built-in spreadsheets, charting, and matrix math.

The Windows products we reviewed all include visual design tools that shield the programmer from the Windows application programming interface (API). GFA-BASIC and CA-Realizer provide a substitute API that is simpler to use but also provide access to the Windows API.

Another important addition to many BASIC development systems is database support. CA-Realizer, Version 2.0, will include support for Xbase's .DBF files and for open database connectivity (ODBC) drivers. True BASIC includes a B-tree indexed file-handling system. VB for DOS and Microsoft PDS include an indexed sequential access method (ISAM) database engine. True BASIC, VB for DOS, and Microsoft PDS only support single-user databases. In con-

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Our Contributors: NEIL J. RUBENKING is the technical editor of *PC Magazine*. DAVE BROWNING is president of Browning Software Systems, a software development and consulting firm. JON BURKE is a freelance writer and heads Business Logic, a computer consulting firm. SHERYL CANTER is a former associate editor of and a frequent contributor to *PC Magazine*. RICK KNOBLAUGH is a frequent contributor to *PC Magazine*. THOMAS MACE was the editor in charge of this story, and JAY MUNRO was the project leader.

trast, Version 3.0 of VB for Windows includes the Microsoft Access, Version 1.1, engine, a full-featured multiuser engine that can access many different file formats.

THIRD PARTIES INVITED

If the language you're considering doesn't offer all the features you need, third-party tools may be available to fill the gap. A rich aftermarket for some BASIC development systems adds to their power and makes up for weaknesses. Here, PowerBASIC, Microsoft PDS, and Visual Basic are particularly well-supported.

As we went to press, Carmel, Calif.-based riscA International was still in beta stage with its PC BASIC compiler, XBasic, Version 2.0, previously available only on the RISC platform. A 32-bit- or 64-bit-only compiler, XBasic is aimed squarely at Windows 3.1 and Windows NT developers. Like Visual Basic for Windows, XBasic's highly graphical development environment integrates a GuiDesigner module that automatically converts your windows designs into functions and adds them to your program. If riscA can actually deliver on the ease-of-use and raw power promised in the preliminary manuals, then would-be Visual Basic buyers might want to give XBasic a look.

BASIC, in both procedural and event-driven incarnations, has come to full maturity. The richness, variety, and power of the available products are evident in the reviews and test results that follow.

GFA Software Technologies

GFA-BASIC for DOS
GFA-BASIC for Windows

BY DAVE BROWNING

GFA-BASIC, an application development language that is popular in Europe, offers extremely rich functionality—at a price. Distributed in the United States by GFA Software Technologies, GFA-BASIC is available for several computer platforms. We examined GFA-BASIC for DOS, Version 4.43 ($235) and GFA-BASIC for Windows, Version 4.2 ($395). While both offer powerful feature sets, those strengths are offset by a bare-bones development environment and weak documentation (especially in the DOS version). Significant upgrades to both products, due as we go to press, may change the picture considerably.

LANGUAGE POWER

With over 500 commands and functions in the DOS version and over 800 in the Windows version, features abound for the serious programmer. Old C hands, especially, will appreciate niceties such as ++, +=, —, -=, *=, and many more immediate arithmetic and bit-manipulation commands. You can access CPU registers including the full 32-bit 386 registers and invoke DOS interrupts (though only DOS interrupt 21 and NetBIOS in the Windows version). You can manage memory directly with MALLOC() and MSHRINK() and use the Expanded Memory Specification (EMS) in the DOS version, including redirection to disk when EMS is not available. Pointer functions provide powerful C-style indirection. All variables are global unless declared local within a procedure, the reverse of most other BASICs.

GFA-BASIC's flexible looping structures support any combination of DO, WHILE, REPEAT, DO WHILE, and DO UNTIL headers with any LOOP, LOOP UNTIL, LOOP WHILE, WEND, or UNTIL trailers. Similar to C's often-used switch statement, GFA-BASIC's SELECT CASE allows a CONTinue statement to continue checking with the next case. Structured programming is

SUITABILITY TO TASK

GFA-BASIC for DOS

	POOR	FAIR	GOOD	EXCELLENT
Professional development	●	●	○	○
Quick development	●	○	○	○
Finance and statistics	●	●	●	○
Business graphics	●	●	○	○

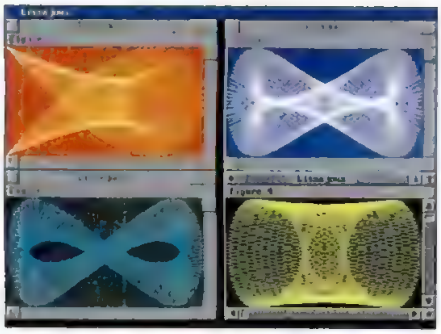
EDITORS' CHOICE

- **PowerBASIC, Version 3.0**
- **Microsoft Visual Basic for Windows, Version 3.0, Professional Edition**

BASIC developers who write DOS applications expect the same from their programming tools as anyone else does: powerful language syntax, a high-productivity development environment, a fast and efficient compiler, solid documentation, a good selection of third-party tools, and intangibles such as the vendor's dedication to the language and its user base. These are tough criteria, and almost every product we looked at came up short.

But not PowerBASIC, Version 3.0. Our Editors' Choice in the DOS category, it delivered in almost every regard. Its impressive feature set includes a wide selection of data types (including user-defined), support for unlimited string space, and the ability to create and manipulate large bit arrays. Its powerful editor and debugger make for fast development, and its in-line assembler is unique to the reviewed products. The fast compiler generates highly efficient executables for a wide variety of CPU/FPUs. The package also supports TSR development. While price may not be a major issue for a professional development tool, the $149 price can't help but be attractive, and the product's documentation and support are exemplary.

Microsoft BASIC Professional Development System (PDS) remains a serious contender in the DOS BASIC arena, but Visual Basic (VB) is the core of Microsoft's BASIC strategy. Microsoft states it will continue to sell and support PDS but refuses to comment on whether it will be upgraded. Microsoft PDS is a



You'll enjoy the slick windowing of GFA-BASIC for DOS—if you can learn to navigate the spartan development environment.

emphasized as the GOSUB command only calls declared procedures, not line numbers or labels as in other BASIC languages.

Although it lacks specific financial functions such as internal rate of return and net present value, GFA-BASIC boasts an extensive collection of mathematical functions including a complete set of matrix arithmetic operations; factorial, permutation, and combination calculations; and hyperbolic trigonometry functions. Graphical capabilities include Bezier curves, clipping boundaries, and rectangle overlap detection. The DOS version includes commands for graphical windows with scroll bars, maximize and minimize icons, and other Windows-like attributes. Both versions include an event-driven menu bar and pull-down menus.

ENVIRONMENTAL DISTRESS

The development environment of the current DOS version is quite austere, with no interactive debugger, no screen-design aids, and a cumbersome editor based on WordStar keystrokes. Mouse support is provided, however.

GFA-BASIC for Windows' environment is decidedly better, though still not as tightly integrated nor as powerful as some others. The text editor is unnecessarily awkward, since scrolling and edit keystrokes don't follow standard Windows style. The interactive debugger is functional but limited: You can watch up to six variables (but not expressions), set a maximum of six breakpoints, and step through code line by line without single-stepping through called routines. However, during debugging you can't edit source code, choose a different NEXT statement, or use the Direct window to examine variables.

KNOW YOUR WINDOWS

GFA-BASIC for Windows is closely coupled with Windows—a plus if you are familiar with Windows programming, a minus if you want to be insulated from Windows complexity. GFA-BASIC handles notification of Windows events such as keystrokes, mouse clicks, timer events, or screen repaints differently from other compilers: It provides a structure (called a menu array) that you monitor in a program loop containing a SLEEP command.

A rudimentary dialog-box development aid with a toolbox of common controls helps you create dialog boxes. These may then be saved as resource files and called from the source program or integrated as source code into the program. Windows calls are built in with no additional declaration needed, and many are implemented in simplified form as GFA-BASIC commands, such as the STRETCH command that resizes a bitmap in a window. Windows common dialog boxes for color, font, file, and print management are also built in, and metafile and clipboard operations are available.

SUITABILITY TO TASK

GFA-BASIC for Windows

	POOR	FAIR	GOOD	EXCELLENT
Professional development	●	●	●	○
Quick development	●	●	○	○
Finance and statistics	●	●	●	○
Business graphics	●	●	○	○

COMPILATION AND PERFORMANCE

In addition to producing interpreted execution, both versions can produce executable files that use either a runtime overlay (DOS) or a DLL (Windows). The Windows version can also produce standalone .EXE files. The DLL capability is especially useful to programmers who need an application DLL and would pre-

FACT FILE

GFA-BASIC for DOS, Version 4.43

GFA-BASIC for Windows, Version 4.2

GFA Software Technologies Inc., 27 Congress St., Salem, MA 01970; 800-766-6432, 508-744-0201; fax, 508-744-8041

List price: *DOS version:* $235 *Windows version:* $395

Requires: *DOS version:* 640K RAM, DOS 3.1 or later. *Windows version:* 2MB RAM (4MB recommended), 2.5MB hard disk space, DOS 3.3 or later, Microsoft Windows 3.0 or later

In short: A language system available for DOS, Windows, and a number of other platforms with good cross-compatibility between versions. GFA-BASIC provides a multitude of powerful commands and built-in functions, optimization for target hardware, extensive mathematical operations, a true compiler for the Windows version (the DOS version will be available by the time you read this), and blazing speed. But its complexity and limited development environment (especially in the DOS version) means it is aimed at experienced programmers only.

487 ON READER SERVICE CARD

fine product with a strong feature set and large following among professional developers. But in this climate, DOS developers would do better to look beyond Microsoft.

In a Windows-centric BASIC, you probably want data access and power, avoiding the API-intensive high ground staked out by various C++ systems.

Visual Basic for Windows, Version 3.0, Professional Edition, our Editors' Choice honoree among Windows BASICs, clearly has the edge. While VB continues to enable event-driven Windows programming for mere mortals, this release adds support for Object Linking and Embedding (OLE), Version 2.0, and significant data-centric features including the multiuser database engine from Microsoft's Access and a complement of data-aware controls. Code performance is as fast as some DOS BASICs, and documentation and support are excellent. Given VB's central position in a strategy that includes OLE, Version 2.0, Microsoft's office applications, and even Windows itself, you can be sure of VB's support for a long time to come.

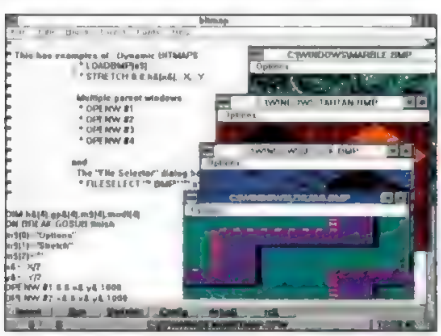
Product Photography by Thom O'Connor

fer to take advantage of GFA-functions rather than recreate them in C. This DLL capability also enables you to combine, say, Visual Basic's superior user-interface development environment with GFA's high-horsepower processing engine. A new Windows compiler, slated for release at presstime, will provide support for multimedia and Visual Basic commands.

In performance testing, both versions of GFA-BASIC fared very well, especially in math operations and file I/O.

THE WEAK LINK

Even for the experienced programmer, the GFA-BASIC for DOS documentation—all in one ring binder—is adequate at best. Typographical errors abound and example programs use obscure variable names and contain few comments. The GFA-BASIC for Windows documentation is much better. The compiler and linker user's guides provide good, detailed technical information and discussions of options, and on-line help is available. Support is provided via telephone or fax and on the CompuServe Windows third-party forum.



This GFA-BASIC for Windows demonstration program lets you choose four bitmaps, open them in four windows, and resize them.

The GFA-BASIC language can provide the heavy horsepower for just about any professional need, and the added functionality of the Windows version offers a nuts-and-bolts alternative to C or assembler for augmenting Visual Basic or similar tools. But the assumption here is that you are an experienced—and patient—programmer, since the packages' awkward environments can be an invitation to frustration. It remains to be seen how well GFA's promised upgrades — DOS, Version 4.5 and Windows, Version 4.3—turn the situation around.

Microsoft Corp.

Microsoft BASIC Professional Development System

BY RICK KNOBLAUGH

As the name implies, Microsoft's $495 BASIC Professional Development System (PDS), Version 7.1, is aimed at the pros who grind out business applications for a living. If that's what you do, this package does it all—or, almost all. PDS is technologically a generation behind Visual Basic—Microsoft's showcase BASIC implementation—and its bundled libraries and toolboxes are not as powerful as a hand-picked combination of third-party add-ons. Still, the PDS delivers a one-stop-shopping solution that will handle many development requirements.

SUITABILITY TO TASK

Microsoft BASIC Professional Development System

	POOR	FAIR	GOOD	EXCELLENT
Professional development	●	●	●	●
Quick development	●	●	●	○
Finance and statistics	●	●	●	●
Business graphics	●	●	●	○

The PDS provides an integrated environment that offers both a threaded p-code interpreter and a true compiler. Even with just the included add-ons, programmers can still deliver powerful DOS and character-based OS/2 applications. Programs generated with the system are quite efficient, in terms of both size and speed.

TWO IDES IN ONE

The PDS includes two complete integrated development environments. QuickBASIC Extended (QBX), available only under DOS, provides a speedy interpreted environment. The Programmer's WorkBench (PWB) supports DOS and OS/2 1.1 and integrates Microsoft's editor and CodeView debugger with the BASIC 7.1 compiler, linker (LINK), make utility (NMAKE), and Source Browser. While QBX is decidedly more user-friendly, the PWB is useful if you are mixing languages in your application or if you are building and debugging programs under OS/2.

The QBX environment boosts development productivity with its context-sensitive help, mouse support, integrated editor and debugger, instant syntax checking, and threaded p-code incremental compilation. Using this approach, QBX is able to provide the instant feedback of an interpreter while maintaining much of the speed of a true compiler. In addition, the QBX's Immediate window allows you to execute BASIC expressions directly—ideal for experimenting or for displaying program variables.

The QBX editor supports most editing features, including full undo/redo of the last 20 editing operations. As you enter source code, each line is checked for legal syntax (if you so choose) and recognized BASIC keywords are forced to uppercase. During compilation, the program displays error messages for any syntax errors. In addition, positioning the cursor over a BASIC keyword and pressing F1 produces an excellent display describing the usage of that particular language element.

The debugger in QBX supports expression watches, watchpoints, and

FACT FILE

Microsoft BASIC Professional Development System, Version 7.1

Microsoft Corp., One Microsoft Way, Redmond, WA 98052-6399; 800-426-9400, 206-882-8080

List price: $495
Requires: 640K RAM (EMS, Version 4.0 recommended), DOS 3.0 or later or OS/2 1.1 or later
In short: A complete BASIC development system geared toward professional programmers. The PDS's support for overlays allows programs to be as large as 16MB, and its integrated ISAM engine facilitates database handling. The included libraries and toolboxes make building in financial functions, creating a character-based user interface, and displaying presentation graphics easy. The package is a standard in development shops thanks to its strong feature set and excellent third-party support, but uncertainty surrounding Microsoft's upgrade plans for the PDS indicates you should choose another environment.

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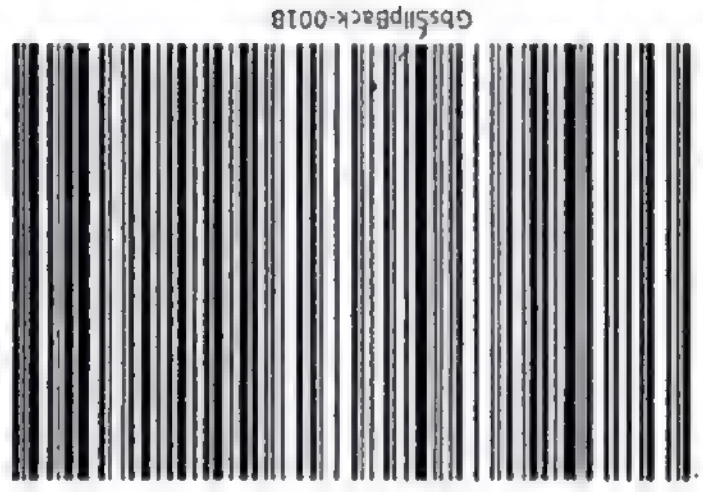

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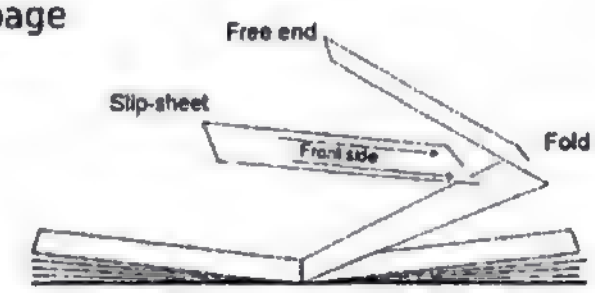

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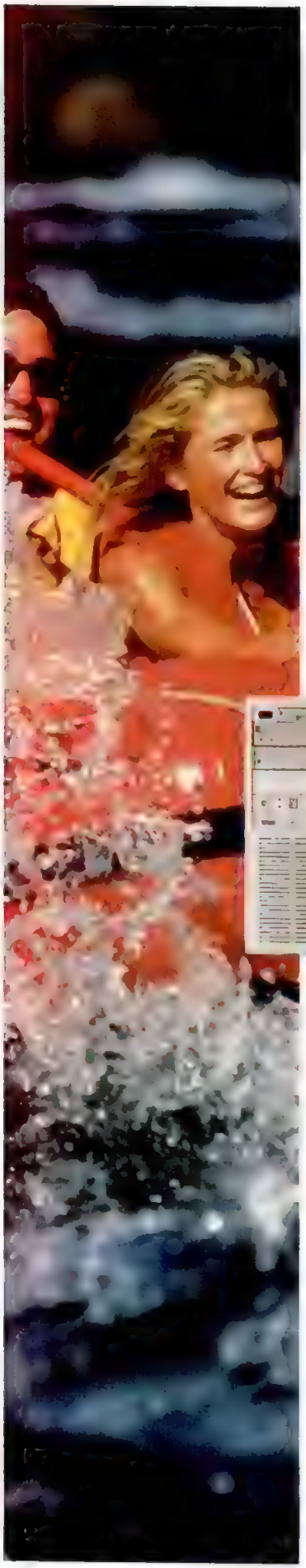

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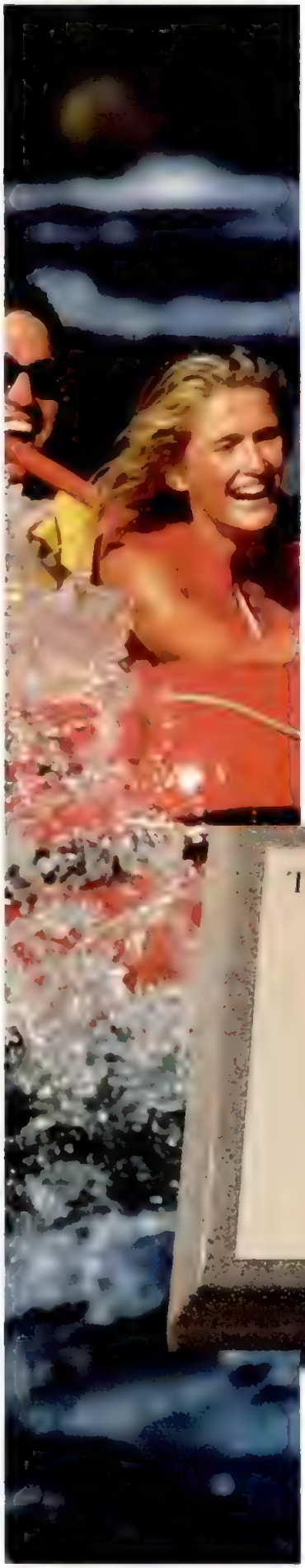

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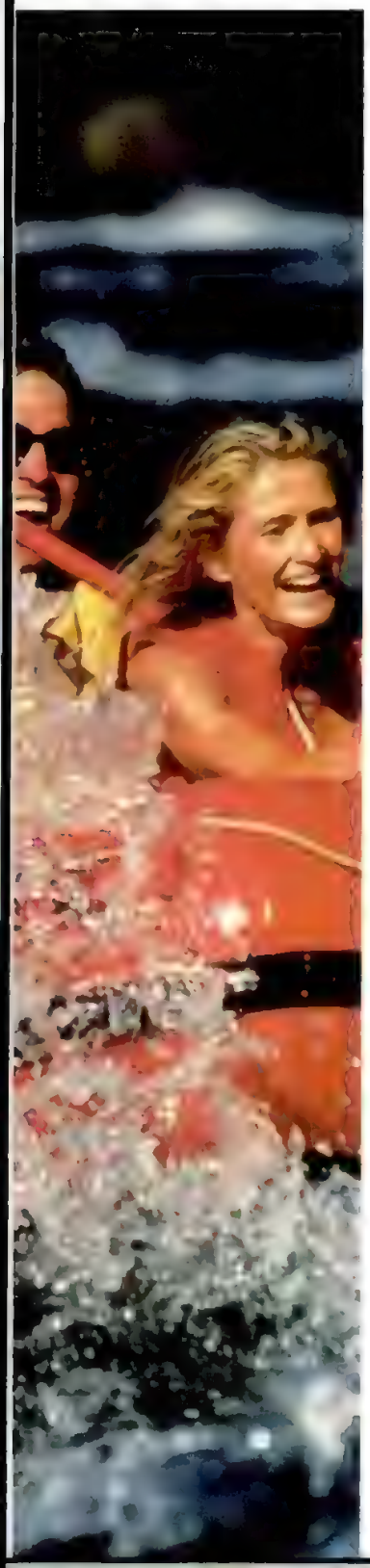

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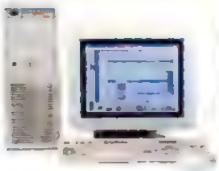	• **60MHz Pentium** **$6,989** • **66MHz i486DX2** **$4,049** • **50MHz i486DX** **$3,999** • **Lease for as low as $140/Month**	• 64-bit Pentium processor* • 4 or 8* MB RAM • Up to 256 KB cache • 426 MB SCSI hard drive • 6 EISA slots • 5 drive bays	• User-upgradeable CPU • 3.5" floppy drive • Microsoft's Ready-To-Run MS-DOS 6.0/Windows 3.1 • 101-key keyboard • Mouse * With Pentium systems

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Visual Basic: *Universal Macros*

By Sheryl Canter

If you are using Microsoft products, soon you won't have to worry about learning a different macro language for every application you use. Word, Excel, and every other Microsoft application will soon share a common macro language: Visual Basic for Applications. VB for Apps will not be a standalone product but will be built into Microsoft's standard suite of office applications. If you've already done quite a bit of programming in Microsoft's current macro languages, don't worry: The existing macro languages will also still be supported.

While the initial release will lack some of the custom controls found in shrink-wrapped VB Windows products, it will contain some features not found in standalone versions. But Microsoft's long-term goal is for all editions of VB to share the same engine, so eventually VB for Apps and the standalone editions will contain the same feature set.

VB for Apps is slated to debut in the upcoming Excel, Version 5.0, which has been promised by the end of the year. Version 4.0 of Project, also containing VB for Apps, will be released shortly thereafter. However, , new releases of Word, Access, and others containing VB for Apps won't appear for at least a year. Microsoft plans to eventually place it in end user products for all platforms, including its application for the Macintosh and Windows NT.

NEW POWER IN MACROS

"Macro language" is something of a misnomer when applied to VB for Apps. Although it has the traditional recording option of a macro language, VB for Apps is a true programming language with a full set of code-creation and debugging tools. Even the recording option works differently; it records the functions underlying your keystrokes rather than the keystrokes themselves. And because it is a true programming language, some tasks that are awkward for traditional macro languages are simplified. For example, Excel VB for Apps will eliminate the cell-naming step when using variables in macros; cell names will be part of the programming language's name space.

The object-oriented approach of Visual Basic for Apps will make performing complex tasks needed in developing vertical applications easier. An objectbrowser in the development environment provides a list of exposed objects and their associated properties and methods. Properties affect an object's appearance—for example, the font property in a cell object.

Although it has the traditional recording option of a macro language, VB for Apps is a true programming language with a full set of code-creation and debugging tools.

Methods are things the object can do. Through OLE 2.0, VB for Apps can also access objects—along with their properties and methods—from other applications.

OLE 2.0: ENGINES AS OBJECTS

One of the most important features of the new Visual Basic engine is its support for OLE 2.0, a central part of Microsoft's plan for cross-platform, cross-application integration. With OLE 2.0's automation interface, you can go beyond the data sharing of OLE 1.0 to actually pass commands to remote applications.

This has a number of far-reaching implications. The power of the objects from the most sophisticated commercial application engines in the marketplace will be available for use in developing your own programs.

For example, you'll be able to include a word processing component in an Excel application by using Visual Basic for Apps to access the Word engine. A registration file within Windows, updated when you install an OLE 2.0 application, is used to keep track of which engines are available for use.

The power of OLE 2.0 is impressive, but it comes at a price. To support OLE 2.0, existing applications must be rewritten to give access to the components of their engines.

Here, Microsoft applications clearly have the lead. The OLE 2.0 specification is also far from straightforward. To jump on the OLE 2.0 bandwagon, developers will have to make a substantial investment in development time. But OLE 2.0 is a central part of Microsoft's operating system strategy, and the company will no doubt support OLE for a long time to come.

Developers won't have to remember five different macro languages for five different applications, and that alone will bring a sigh of relief to those who do a lot of macro programming. But the accessible power and OLE 2.0 support of Visual Basic for Apps are even more significant, raising macro programming to the level of true programming.

Though Microsoft claims that its main goal for Visual Basic is to make professional applications development an easier task, a happy side effect is that you will no longer need professional-level programming skills to write powerful, full-featured applications.

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breakpoints. However, if you want to view CPU registers, dump specific memory areas, or unassemble code, you must use the standalone CodeView debugger.

THE PWB AND CODEVIEW

Although less intuitive than QBX, the PWB is a powerful base from which to edit, perform builds, browse code, and debug with CodeView. Any compilation errors are displayed in the Compiler Results window. Hotkey combinations let you move back to previous errors or forward to the next.

Debugging with CodeView is a pleasure. Individual sizable windows are used to accept commands and display local variables, watch variables, registers, and program source code. Source code can be displayed in disassembled format, source format only, or a mixture of both—an excellent way to understand exactly which code the compiler generated. Throughout the PWB, the outstanding help system provides an extensive cross-referenced database covering BASIC syntax, compiler options, utilities, and error messages. Sample code within help can be cut-and-pasted into your programs.

The Microsoft BASIC PDS Advisor help system provides sample code that you can cut and paste into your program.

WELL-FILLED TOOLBOX

The included libraries and toolboxes are a real boon to developers. Three tried-and-true Excel-derived libraries supply date/time, financial, and numeric formatting functions.

The integrated indexed sequential access method (ISAM) engine allows you to develop single-user database applications (multiuser projects require a more powerful third-party engine). ISAM supports multiple tables, multiple indexes, and data files with sizes of up to 128MB.

The user-interface toolbox lets you add character-based windows, pull-down menus, list boxes, and the like to your applications; you cannot, however, use visual tools to design your screens. The presentation-graphics toolbox includes code for generating on-screen displays of pie charts, bar and column charts, line graphs, and scatter diagrams. You can manipulate the appearance of the graphs, but there is no provision for printing them.

STRONG LANGUAGE

The language itself also contains some noteworthy features. Among the more powerful are constants, user-defined data types, software interrupt access via CALL INTERRUPT, and control structures such as DO/LOOP and SELECT CASE. In addition, a new data type for currency provides speedy performance and memory efficiency when crunching dollars and cents.

You can build programs into standalone .EXE files or into smaller .EXE files that rely on a supplied runtime module. The use of overlays is also supported, allowing you to create programs of up to 16MB. Overlays swap to EMS (if present) or disk, freeing conventional memory for dynamic array and string space. The performance of PDS-generated executables is generally strong, especially in the areas of string manipulation and graphics.

The PDS includes excellent documentation and many sample programs that demonstrate the features of the language and the libraries and toolboxes. Just hope you don't have any questions after using these, because, except for handling initial product setup questions for free, Microsoft charges for technical support: $2 per minute on a 900 line or a $20 charge to your credit card.

The PDS is a strong product with a large user community and solid third-party tool support. The only significant downside is the apparent cloud over its future as Microsoft funnels resources into its highly strategic Visual Basic products. Microsoft has indicated that it will continue to sell and support PDS, but it won't comment about future upgrade plans. Given the situation, developers might be better off moving to a BASIC environment with a guaranteed future.

Microsoft Corp.

Microsoft Visual Basic for DOS
Microsoft Visual Basic for Windows

BY SHERYL CANTER

When Microsoft Visual Basic for Windows first appeared in 1991, it popularized a revolutionary, event-driven, visual paradigm for Windows programming. Visual Basic for Windows, Version 3.0 (VB3), released this past June, is more powerful than ever, adding the Access database engine and a complement of data-access controls. It is also the first shipping application to support Microsoft's new OLE, Version 2.0.

Some 15 months after Visual Basic first appeared, Microsoft released Visual Basic for DOS, Version 1.0 (VBDOS). This product hasn't been updated since we last saw it (see First Looks, *PC Magazine*, November 24, 1992), so most of this review will concentrate on the new Windows version. Both VB3 and VBDOS come in two editions: Professional ($495) and Standard ($199). The Standard edition of VB3 includes support for the Access engine and OLE, Version 2.0, while the Professional Edition adds data access objects and data aware controls, support for open database connectivity (ODBC), a WYSIWYG report writer (Crystal Reports, Version 2.0 for Visual Basic, from Crystal Services), the Custom Control Development Kit, and an on-line Windows 3.1 application programming interface (API) reference.

The Standard edition of VBDOS is comparable to Microsoft QuickBASIC, while the Professional edition resembles Microsoft BASIC Professional Development System in tools and features. Both VBDOS editions differ from the other Mi-

SUITABILITY TO TASK

Microsoft Visual Basic for DOS

	POOR	FAIR	GOOD	EXCELLENT
Professional development	●	●	●	○
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Finance and statistics	●	●	●	●
Business graphics	●	●	○	○

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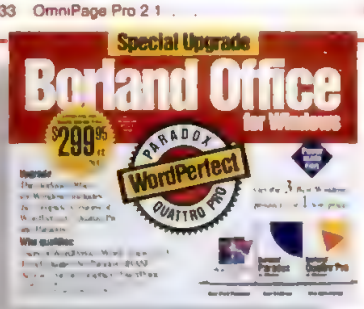

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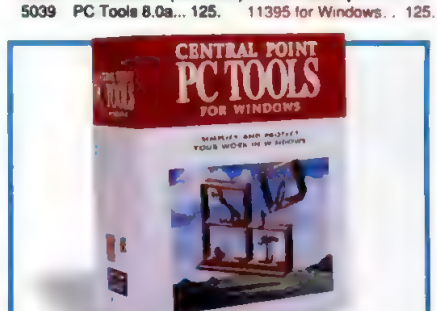

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Pascal: *How Does it Compare?*

by Neil J. Rubenking

Many programmers will tell you that Pascal is a whole lot faster, smaller, cleaner, and more well-structured than BASIC. Looking at the evolution of these two languages, you can see where this opinion comes from. Yet both languages have long been on converging tracks. Today, their differences are much more a question of philosophy and programming style than downright capability. Their market positions are vastly different, however. The BASIC language is supported by a large number of vendors, while Pascal is a de facto property of Borland International.

A LITTLE HISTORY

Pascal started life in 1968, just a few years after the introduction of Dartmouth BASIC. Both Pascal and BASIC were designed as teaching tools, but Pascal was intended specifically to teach good programming style, something that early BASIC versions didn't encourage. From the start, Pascal rejected BASIC's GOTOs and on-the-fly variable definitions. Pascal programs were neatly organized into procedures and functions with discrete entry points and variables defined before use.

But the original Pascal lacked the breadth and power needed for serious application development. That changed in 1983, when then-tiny Borland brought out Turbo Pascal, a new compiler that broke all the rules. Selling for a tenth the price of some competitors, it was far better in many ways. Its IDE merged a blazingly fast single-pass compiler with a built-in editor, letting you compile and run programs directly from the development environment.

Subsequent releases added practical extensions to the Pascal language such as a string data type, enhanced file input/output routines, and potent commands such as Move for copying blocks of memory. Later, provision was made to allow 64K apiece for program code, data, and stack segments; numeric coprocessor support; overlays; and PC-specific graphics.

Continuing enhancements kept Turbo Pascal at the cutting edge of compiler technology. Version 5.0 added an integrated debugger and the optional external Turbo Debugger for heavy-duty debugging. With Version 5.5, Turbo Pascal embraced object-oriented programming, borrowing concepts from C++. The highlights of Version 6.0 were a built-in assembler and Turbo Vision, an object-oriented application framework designed to speed the development of applications. About the same time, Turbo Pascal for Windows made its debut, sporting comprehensive access to the Windows API and its own application framework called OWL (Object Windows Library).

STATE OF THE COMPILER

Borland Pascal, Version 7.0, the current incarnation, is a professional development environment that bears little resemblance to its tiny progenitor. A full installation uses 27MB of disk space and includes IDEs for both DOS and Windows. The DOS IDE uses DOS extender technology to compile huge programs. Using either IDE, you can compile programs for Windows, DOS, or DOS protected mode. With a few minor exceptions, Borland Pascal has all the power of C combined with an easily understood syntax that averts many common programming errors.

PASCAL

```
USES Crt, Drivers;
VAR
  Ans          : Char;
  Work         : String;
  Start, Done : LongInt;
  X            : Word;
  Number1      : Text;
  Timer        : LongInt ABSOLUTE $0040:$006C;

PROCEDURE SyncTimer;
BEGIN
  Start := Timer;                  {synch to new}
  REPEAT UNTIL Start <> Timer;  {timing cycle}
END;

WriteLn; Write('Test writing or reading? (W/R) ');
REPEAT
  Ans := UpCase(ReadKey);
UNTIL Pos(Ans, 'WR') > 0;
WriteLn(Ans);

FillChar(Work, SizeOf(Work), 'A');
Work[0] := #95;                    {build string}
```

BASIC

```
SyncTimer:
Start! = TIMER                     'synch to new
DO WHILE Start! = TIMER            'timing cycle
LOOP
RETURN                             'all done

PRINT : PRINT "Test writing or reading? (W/R) ";
DO
  Ans$ = UCASE$(INKEY$)
LOOP UNTIL INSTR(" WR", Ans$) > 1
PRINT Ans$

Work$ = STRING$(95, 65)            'build string
```

CODE COMPARISONS

Both Pascal and BASIC use English-like keywords for ease of comprehension. In truth, modern BASIC programs look a lot like Pascal programs. The code at the bottom of the figure shows snippets of the Microsoft BASIC program FILEIO.BAS, used for the file I/O tests in this roundup. We translated the snippets as literally as possible into Borland Pascal (top) to show some similarities and differences between the

two languages (the complete text of FILEIO.PAS is available on ZiffNet).

The first line of the Pascal version is a Uses clause that incorporates the standard units Crt and Drivers. This ability to choose which standard units a program will use helps keep compiled Pascal programs small. Many BASIC compilers, including Microsoft's, link in more runtime code than is necessary.

Both also have a SyncTimer subroutine (a procedure in Pascal-speak). The BASIC subroutine calls the built-in function TIMER, which uses the PC's internal timer tick count—a long integer at absolute address 0040:006C—to calculate the number of seconds since midnight. Borland Pascal doesn't have a TIMER function, but it gives you easy access to any absolute address. Here the variable Timer corresponds directly to the timer tick count.

The second portion of the example compares the lines of code that begin the main body of each program. They are amazingly similar; just replace PRINT with Write, DO..LOOP UNTIL with Repeat..UNTIL, UCASE$ with UpCase, INKEY$ with ReadKey, and so on. Note that the structure hardly changes at all.

The BASIC program uses the STRING$ function to create a string of 95 As. Pascal doesn't have an exact equivalent for STRING$, but its FillChar function will fill any data structure with any byte or character.

As you can see, Pascal and modern BASIC have a similar style; knowing one, you can read the other. There is a major difference, however. BASIC supplies built-in higher level functions such as TIMER and STRING$, and a host of other keywords for things like telecommunications, matrix math, and sorting. What comes as a surprise to BASIC programmers is that Pascal doesn't have these. What it does have, however, are the tools to build them yourself.

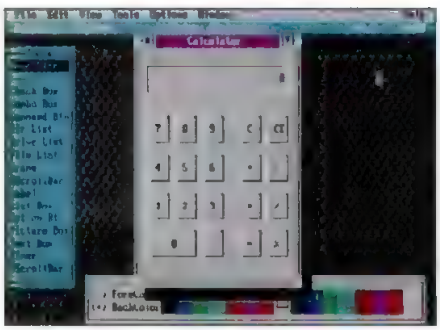
crosoft BASIC products in their incorporation of a forms designer, the visual portion of VBDOS.

VISUAL PARADIGM

Rather than being just another dialect of BASIC, VB3 represents a new way of thinking and working. Its visual development environment is made up of a set of free-floating windows—a form grid, toolbox, properties window, and project window—that can be opened or minimized as needed. A menu with an optional toolbar is contained in its own window at the top of the screen.

VB3 enforces good programming habits by making you start with the user-interface design. Ordinarily, coding the interface is the most complicated and tedious aspect of developing a Windows application, but Visual Basic makes it utterly painless—even fun. You select interface objects from the custom control toolbox, click on the form to place them, and then resize them with the mouse. Once you've designed your form, you can customize the properties and add the program logic. Every interface element in Visual Basic is treated as an object with a set of associated properties (such as color, size, and caption), and events—things that you can do to the object, such as clicking on it with the mouse. Clicking once on an object will bring up its associated property list.

User-written code snippets associated with each event tell the program how to respond to the event; the code window is accessed by double-clicking on the object. Every type of object has its own list of possible events, selected from a list box at the top of the edit window. You can write code to handle more than one event for each interface object.



Microsoft Visual Basic for DOS lets you create a Windows-like user interface in text mode.

Distributing finished applications in VB3 is made easier by a Setup Wizard that automates the process. It selects the necessary custom controls and DLLs, then builds a custom setup program with version checking. The files are then compressed and copied to floppy disks.

FACT FILE

Microsoft Visual Basic for DOS, Version 1.0, Professional Edition

EDITORS' CHOICE

Microsoft Visual Basic for Windows, Version 3.0, Professional Edition

Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-426-9400, 206-882-8080

List price: $495 each.

Requires: *DOS version:* 640K RAM, 11MB hard disk space, DOS 3.0 or later *Windows version* 286-based PC or better, 4MB RAM, 40MB hard disk space, Windows 3.0 or later, mouse

In short: Fast becoming a standard by which other development tools are judged. Version 3.0 of Visual Basic for Windows adds the powerful multiuser Microsoft Access database engine and support for OLE, Version 2.0 The Professional Edition offers additional database support in the form of data access objects, data aware controls, and a WYSIWYG report writer. If you've been using Visual Basic for Windows for database development, you'll want to snap up Version 3.0. Visual Basic for DOS, which has not been upgraded since its release, offers a text-mode forms designer that uses the event-driven model of the Windows product.

480 ON READER SERVICE CARD

NEW WITH VERSION 3.0

The big news with VB3 is that it incorporates the Microsoft Access, Version 1.1, database engine. The Professional edition also includes data access objects and data aware controls to reduce the amount of code you need to write to utilize the engine. The database engine lets developers access FoxPro, dBASE, Paradox, Btrieve (with a Btrieve runtime library), and Access databases, as well as other formats via ODBC. ODBC drivers for Microsoft SQL Server, Sybase SQL Server, and Oracle Server are included with the package.

The Access engine provides rich multi-

SUITABILITY TO TASK

Microsoft Visual Basic for Windows

	POOR	FAIR	GOOD	EXCELLENT
Professional development	●	●	●	●
Quick development	●	●	●	●
Finance and statistics	●	●	○	○
Business graphics	●	●	●	●

user support with transaction processing (the ability to commit and roll back database changes), optimistic and pessimistic locking, support for rich data types (sound, video, OLE, bitmaps, and so forth), distributed joins, and query optimization.

The other main addition to Version 3 is support for OLE 2. The most important advantage of OLE 2 is its automation feature, which lets you incorporate features of commercial applications that support OLE 2 into your own applications—an Excel element in a Word-based program, for example. While this will eventually be an extremely powerful feature, at the time of this writing no additional OLE 2 applications have been released.

Also new in VB3 is the pop-up menu command, which lets developers create context-sensitive menus activated via the right mouse button.

VB3 is designed for corporate productivity and ease of use, and lets you create full-featured Windows applications without writing a line of interface code.

THE LANGUAGE ITSELF

VB3 is designed for corporate productivity and ease of use, and lets you create full-featured Windows applications without writing a line of interface code. Because of this focus, the language syntax lacks the low-level power of leading DOS BASIC dialects. For example, VB3 does not support pointers, byte variables, or unsigned integers, and a Microsoft spokesperson says the company has no plans to add these kinds of low-level features to the product.

VB3 compiles to threaded p-code, and a hefty 394K runtime DLL—which can be distributed at no charge—is needed for executing even a simple program. Separate DLLs for the Access engine, OLE, and the ODBC drivers can add up to 2MB of runtime code. The execution speed of VB3 programs is acceptable but significantly slower than that of comparable C programs.

VISUAL BASIC FOR DOS

VBDOS has been widely criticized as the poor cousin of VB for Windows. While it does come up short in some areas—notably, performance—it offers something truly alluring: painless interface design and event-driven programming in DOS.

The forms designer is a separate module that is launchable from the code editor. It closely follows the model for the Windows version with its

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Performance Tests: BASIC Compilers

How We Tested

To test the performance of this year's crop of BASICs, we wrote five custom routines that measure the execution speed of selected math, string, and graphics operations; file I/O speed; and minimum useful program size. We wrote the test code in Microsoft BASIC PDS and ported it to the other languages with as few changes as possible. We compiled and ran all test programs on the same Compaq Deskpro 486/33M equipped with 8MB RAM and a 340MB Conner hard disk. All recorded times were generated by the tested packages' internal timing commands. The source code for all tests is available on PC MagNet.

BASIC's **math operations** are used extensively in educational and scientific fields. To test number-handling capabilities, we wrote routines that exercise single-precision, double-precision, and matrix math operations. The first two add, subtract, multiply, and divide two numbers 30,000 times using single- and double-precision variables, respectively. A third routine then calculates the product of an 80-by-80 matrix (built-in matrix functions, where present, were not used). We compiled the tests using all available math and CPU options; the results represent the fastest test speed obtainable for each package. Note that GFA-BASIC and True BASIC default to double-precision variables exclusively.

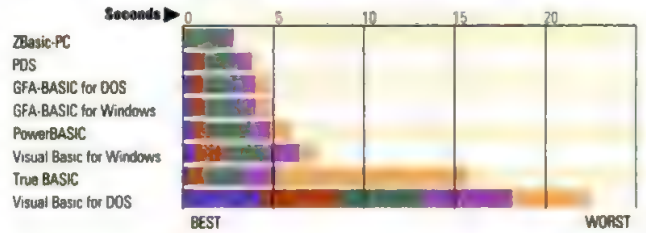
BASIC is justly renowned for its **string operations**, so we selected five types of string handling to look at: assigning a string, concatenating a string, finding a character, extracting a character, and replacing a character. ZBasic-PC's fast time is attributable to the fact that it does not support dynamic string handling.

Programmers have long used BASIC's **graphics operations** for writing everything from games to business graphics applications. We tested a set of six common graphics scenarios. Where differences in graphics syntax between packages made a literal port impossible, we used the closest implementation the language provided. Because GFA-BASIC for Windows and Visual Basic for Windows rely on Windows' Graphics Device Interface for graphics support, their scores were almost identical.

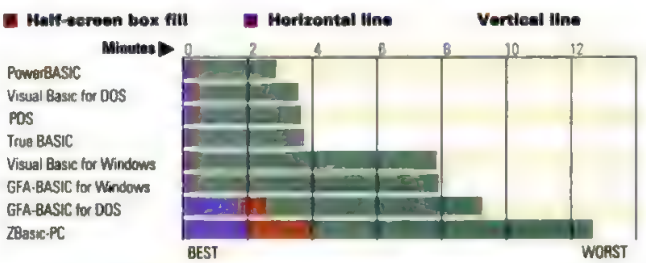
Because so many programs perform **file read/write operations**, programmers are naturally concerned with file I/O efficiency. To test the speed of writing to a file, we created a program that opens a file, writes a string 1,000 times with sequential access to the file, then closes it. Similarly, to test reading from a file, we wrote a program that opens a file and reads in 1,000 lines. The score includes the time required to open and close the file.

Minimum useful program size can be a concern where BASIC is being used to develop small utilities. We created a small utility that changes the repeat and delay speed of the keyboard. The graph shows both the compiled program size in kilobytes and any runtime overhead needed to execute programs in the tested language (GFA-BASIC for DOS and Visual Basic for Windows both require runtime modules. True BASIC's large size is due to the p-code interpreter bound into every compiled executable.

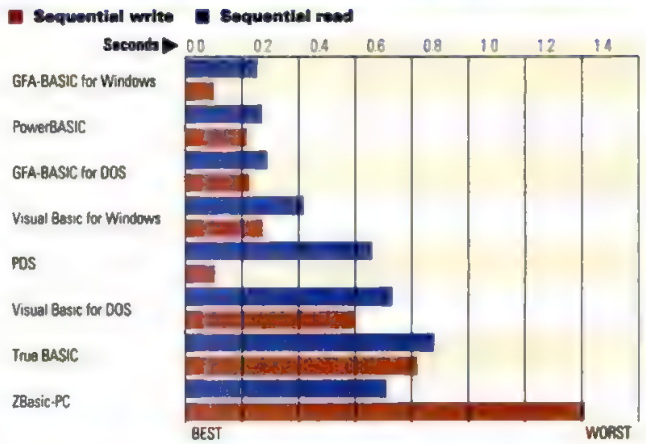
STRING OPERATIONS



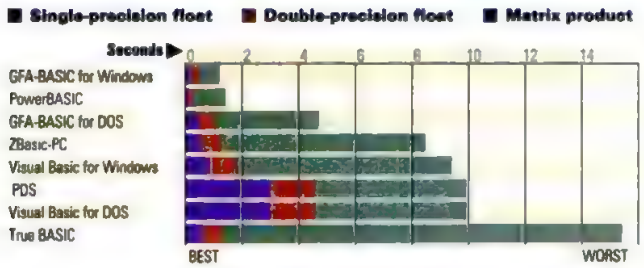
GRAPHICS OPERATIONS



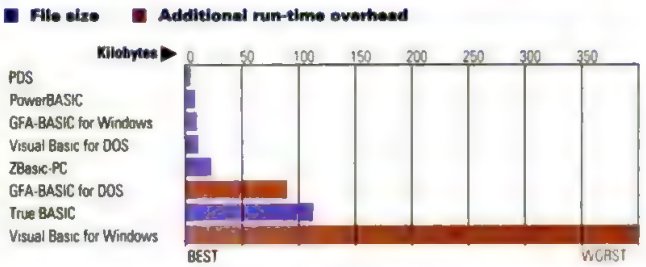
FILE READ/WRITE OPERATIONS



MATH OPERATIONS



MINIMUM USEFUL PROGRAM SIZE



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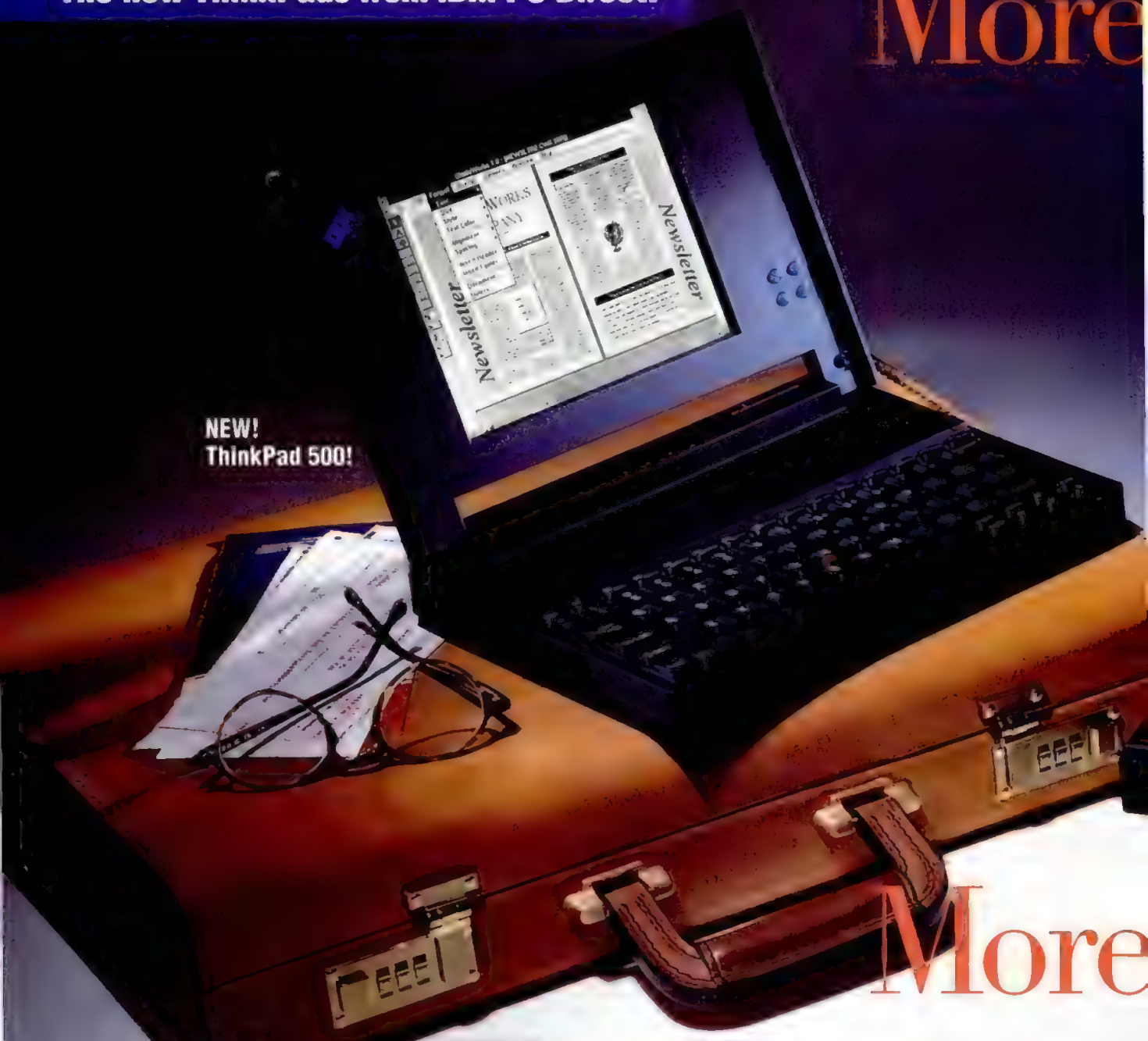
More



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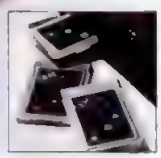

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CA-Realizer: Cross-Platform Power

By Sheryl Canter

If you're holding out for a powerful dialect of BASIC for GUI programming that doesn't force you into an event-driven model, hang on a little longer. CA-Realizer, Version 2.0, may be what you're waiting for.

Scheduled for release by the end of this year, Version 2.0 will be the first release of Realizer since its purchase by Computer Associates. It includes plenty of new features, though many were difficult to evaluate in the late-beta version we tested. Even so, CA-Realizer promises to be a very powerful BASIC development system, supporting both Windows and OS/2 Presentation Manager programming. An NT version is promised shortly after NT's release, and the same CA-Realizer code will run on supported platforms.

POWERFUL NEW FEATURES

New to Version 2.0 is FormDev, a visual design tool that looks very much like Microsoft Visual Basic. But unlike Visual Basic, which is organized as a collection of separate applications, CA-Realizer uses the standard Windows multiple document interface (MDI). This makes for a less cluttered screen but more difficulty in working with large forms.

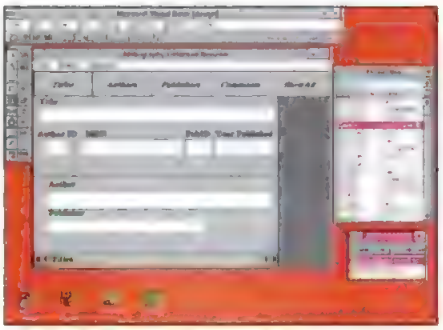
A more significant difference is that instead of storing interface code in a proprietary format, CA-Realizer generates Realizer code in source format that you can extend or modify.

Modified code can be brought back into FormDev with all changes preserved. You can add code to any portion of the interface from within FormDev; the code box is accessible through a dialog box that you bring up by clicking on a menu option.

Realizer's programmable application tools are comparable to the custom controls found in Visual Basic and are accessible via a toolbar in FormDev. The eight tools are the Text Log, Spreadsheet, Boardwatch, Chart, Scheduler, Form, Graphics Tablet, and Animator. Text Logs are used to display and edit text. The Spreadsheet is a full-featured module that provides splitter bars to let you break the spreadsheet into separate areas if desired. The Boardwatch is used to display data in tabular form like a spreadsheet, but the data can only be modified from within an application. A good use of the Boardwatch would be to display stock prices. The Chart provides flexible data-graphing capabilities. The Graphics Tablet, which can be programmed to respond to mouse clicks, lets you work with graphical elements and requires less memory overhead than the Chart. The Animator displays a set of bitmaps in rapid succession to give the impression of movement; a library of clip art is also supplied. The Form brings the elements together, along with standard interface objects.

Additional custom controls can be toolbox and properties list. One difference is that due to DOS memory constraints, you cannot view all object properties simultaneously as you can under Windows. You have to make a selection from the Properties pull-down menu to see its setting in the value box on the right. Like the Windows product, it allows you to add new custom controls to the toolbox.

Programs created with the forms designer are remarkably Windows-like in look and feel, though they are in text mode. For example, a white line around buttons gives a surprisingly effective simulation of 3-D controls. There are shortcomings, though, the most notable being that graphics mode is not supported. You should also be aware that using the forms feature will bloat the size of your compiled program.



Version 3.0 of Microsoft Visual Basic for Windows includes the Access engine, making database development with Visual Basic even easier.

VBDOS is QuickBASIC-compatible with some minor differences. VBDOS has additional commands, but it does not support near strings. A translator utility offers some portability between the DOS and Windows versions of the product, but it does not work perfectly—especially when moving from Windows to DOS. Also, Microsoft BASIC does not support conditional compilation, so you may end up maintaining two versions of your source code.

Ultimately, VBDOS lacks the power of the leading DOS compilers and the Windows leverage of VB3. At the same time, its prowess at creating sophisticated DOS interfaces and as an upgrade path VB for Windows make it a product worth your consideration.

PowerBASIC Inc.

PowerBASIC

BY RICK KNOBLAUGH

If ever there was a product with a history, PowerBASIC is it. Originally developed by Bob Zale, a BASIC guru, the product attracted a big following as Borland's Turbo Basic. When Borland decided to put its efforts elsewhere, Zale took his baby first to Spectra Publishing and then to the newly founded PowerBASIC Inc.

PowerBASIC, Version 3.0, has been enhanced at each stop and has matured into an industrial-strength developer's tool with a powerful integrated environment. At only $149, it also offers outstanding value.

Developers will appreciate its support for flexible data types, generous string space, an in-line assembler, fast compilation, a procedure-based math package, and other features needed for professional programs. Beginners will find the friendly environment, extensive on-line

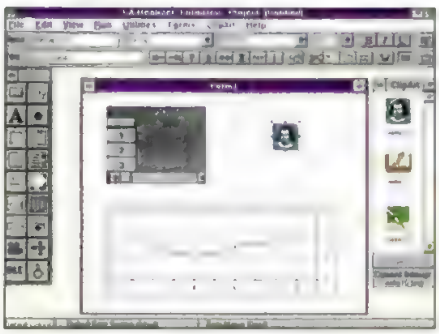
created and integrated into FormDev by creating a DLL with a C program then registering it within FormDev. Instructions for writing custom controls are provided in the reference guide.

Version 2.0 also provides some rudimentary database capabilities. You can read and write Xbase (.DBF) files as well as Excel, Lotus 1-2-3, and CA-SuperCalc spreadsheet files. While there is no multiuser support or indexing, ODBC drivers are supported, making Realizer a viable option for front-end development.

CA-RET, a WYSIWYG report writer, is now integrated into CA-Realizer and can be controlled from within an application. A FormDev utility called Database Form will automatically generate labeled forms from a .DBF file. This feature was not fully operable in the beta we looked at.

THE REALIZER DIALECT

Realizer BASIC has always been an unusually rich dialect, and that remains the case. Luckily, rich doesn't also mean complicated. Commands for manipulating the Programmable Application tools share a common syntax; once you have learned how to use one, learning another is easy.



CA-Realizer's new visual design tool, FormDev, gives you access to eight powerful programmable application tools.

The main module of CA-Realizer, its program editor and debugger, is configurable and relatively easy to use. The program's debugger, which is displayed through a menu option, provides buttons for tracing through code and setting breakpoints and watch variables. A simple button click will bring up a list of program variables, and clicking on another button displays the call tree. Error log and print log windows can be opened or closed.

CA-Realizer programs compile to p-code and require a runtime DLL for execution. The DLL can be freely distributed. The traditionally robust Realizer BASIC, combined with the visual tools and cross-platform support added by Computer Associates, make this package a strong contender for your development dollars.

▶ FACT FILE

CA-Realizer, Version 2.0
Computer Associates International Inc., One Computer Associates Plaza, Islandia, NY 11788-7000; 800-225-5224, 516-342-5224.
List price: *$99 through November 30; $247 thereafter.*
Requires: *2MB RAM (4MB recommended), 8.5MB hard disk space, Microsoft Windows 3.x or OS/2 2.x.*
Circle 490 on reader service card

help, and approachable documentation (not to mention the very reasonable price tag) a welcome invitation to learn the language.

SLICK IDE

PowerBASIC sports a slick IDE as well as command-line versions of its tools. From the IDE, you can seamlessly access the editor, compiler, linker, and debugger through pull-down menus or hotkeys. The PowerBASIC editor includes niceties such as auto-indenting, place markers, and standard block manipulation, though its undo features—all you can do is restore the current line—are a bit weak.

The compiler is exceptionally fast and can output to memory, .EXE files (compiled and linked), chain files (containing no runtime library code), or unit files (to be linked to other mainline code). You can configure the compiler to optimize for size or speed, specify desired math handling (80x87, emulation, or procedural-math package), generate debug information, and generate CPU-specific code (8086/8088, 80286, or 80386). Metastatements—instructions to the compiler that you place in your source code—are provided by all compilation switches. These can be used to specify compile options, conditionally compile sections of code, and control other aspects of code generation. While metastatements are not unique to PowerBASIC, the level of control provided is outstanding.

Beginners will find PowerBASIC's friendly environment, extensive on-line help, and approachable documentation a welcome invitation to learn BASIC.

If errors are encountered during compilation, the program highlights the offending source line and displays an informative error message. After remedying the problem you must recompile, as there is no function to advance the editor to subsequent source lines containing other detected errors.

PowerBASIC's integrated debugger is easy to use, offering a watch window, an evaluation window, and a call-stack display—a record of function and procedure calls. The only notable shortcoming of the debugger is its inability simply to dump or edit specific memory locations; only program variables can be displayed or edited. This, combined with the absence of Register and Unassemble commands, may discourage serious developers from using this debugger—particularly if they are interfacing with assembler code. However, Power BASIC is capable of gen erating .MAP files for providing program symbols to an external debugger (such as Borland's Turbo Debugger).

FLEXIBLE PROGRAMMING

PowerBASIC provides users with a rich instruction set and a variety of flexible data types and features that lend them-

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How does the OverDrive processor do it? Using Intel's innovative DX2 "speed doubling" technology, it runs internally at twice the speed of the rest of your system. So if you had a 33 MHz SX or DX Intel processor, you would now have a 66 MHz DX2 Intel processor.

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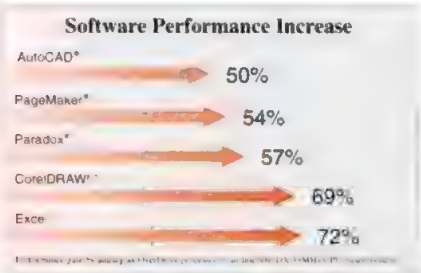

Plus, the OverDrive processor is easy to install. Depending on your system, you can either plug it into the OverDrive socket or swap it with your original microprocessor. No problem.

To get a better idea of how the OverDrive processor boosts performance of your software, call 1-800-354-3112, Ext. 5718, for a free demo disk. It could be the greatest show on earth.

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SUMMARY OF FEATURES

BASIC Compilers

Products listed in alphabetical order

■ = YES □ = NO

	GFA-BASIC for DOS	GFA-BASIC for Windows	Microsoft BASIC Professional Development System	Microsoft Visual Basic for DOS	Microsoft Visual Basic for Windows (PC MAGAZINE EDITORS' CHOICE)	PowerBASIC (PC MAGAZINE EDITORS' CHOICE)
List price	$235.00	$395.00	$495.00	$495.00	$495.00	$149.00
Development Environment						
Allows step/trace execution	■	■	■	■	■	■
Allows watch variables/watch expressions	□□	■□	■■	■■	■■	■■
Allows breakpoints	■	■	■	■	■	■
User can edit and continue after a break	□	□	■	■	■	□
User can break and then resume execution at a different place	□	□	■	■	■	□
Comprehensive on-line help	□	■	■	■	■	■
User can cut and paste between files	□	■	■	■	■	■
Mouse support	■	■	■	■	■	■
User can create executable from within editor	□	■	■	■	■	■
Available memory in editor with no program loaded	350K	Limited only by Windows' virtual memory	Limited only by EMS/XMS	Limited only by EMS/XMS	Limited only by Windows' virtual memory	512K
Multimodule program MAKE support	□	■	■	■	■	■
Executable Programs						
Creates true standalone executable files	□	■	■	■	□	■
Includes executable program debugger	□	□	■	■	□	■
User can add on-line help to programs	□	■	■	■	■	□
Language Features						
Data types supported:						
Bit arrays	■	■	□	□	■	■
Byte variables	■	■	□	□	□	■
Signed/unsigned integers	■■	■■	■□	■□	■□	■■
Long integers	■	■	■	■	■	■
Double-long (8-byte) integers	□	□	□	□	□	■
Single-precision /double-precision variables	■■	■■	■■	■■	■■	■■
Currency (or BCD) variables	□	□	■	■	■	■
Fixed-length strings	■	■	■	■	■	■
TYPE variables	■	■	■	■	■	■
Arrays within TYPE variables	□	□	■	■	■	■
Maximum string length allowed	32K	32K	32K	32K	64K	32K
Supports huge arrays	■	■	■	■	■	■
Supports constants	□	□	■	■	■	■
Supports initialized data	■	■	□	□	□	□
Other Features						
User can require that all variables be declared	■	■	□	■	■	■
In-line assembler	□	□	□	□	□	■
Supports bit operations (AND, OR, NOT, XOR)	■	■	■	■	■	■
User can link subroutines in assembly and other languages	□	■	■	■	■	■ (proprietary syntax only)
Alternative math support (besides coprocessor)	■	■	■	■	■	■
User-defined event handling	■	■	■	■	■	■
Conditional compilation	□	■	□	□	□	■
Overlays	□	N/A	■	■	N/A	□
TSR or interrupt handling	□	N/A	□	□	N/A	■
Binary file access	■	■	■	■	■	■
ISAM file handling/Multiuser ISAM file handling	■□	■□	■□	■□	■■	□□
Network file support (file locking, file sharing)	■	■	■	■	■	■
Screen design, menuing, and data entry	■	■	□	■	■	□
Financial function library	□	□	■	■	■	□
Matrix functions, statistical function and libraries	■	■	■	■	□	□
Graphics function library/charting functions	■□	■■	■■	■■	■■	□□

N/A—Not applicable. The product does not support this feature

True BASIC	ZBasic-PC
$495.00	$149.95
■	■
■□	□□
■	■
□	■
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■	□
■	■
■	□
■	■
330K	64K
□	□
■	■
□	□
□	□
□	□
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□	□
□	□
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□	■
□	■
□	□
N/A	N/A
Limited by free DOS memory	255K
■	■
□	□
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selves to the development of robust programs. The program furnishes control structures such as DO/LOOP and SELECT CASE for effectively controlling program flow. SUB and ENDSUB statements define procedures that are called with parameters passed by value, copy, or reference.

Equates, unions, and user-defined types are supported. User-defined types are similar to structures in C (or records in Pascal) and allow you to define templates that outline memory areas.

User-defined types can be nested and created in arrays. Huge arrays are also supported. You can also specify absolute array locations, and arrays are easily manipulated with the ARRAY statement, which sports powerful options for inserting, deleting, scanning, and sorting array elements.

PowerBASIC supports 11 numeric data types (such as unsigned bytes, words, and dwords) as well as three different string data types, including a PowerBASIC innovation called the *flex string*. Variables of this type are essentially arrays of characters that can be very useful when dealing with data whose length is only known at runtime.

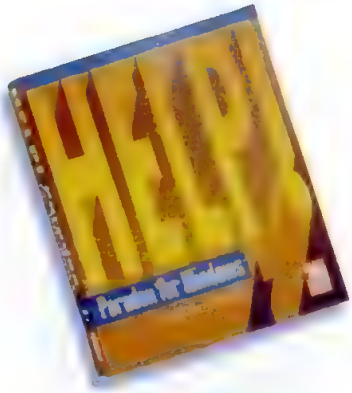
POWER FEATURES

PowerBASIC sets itself apart from the other BASIC compilers reviewed here with a number of clever features. Bit-twiddlers will delight in the full set of bit-level operators and a bit function that facilitates bit arrays, allowing the manipulation of any bit within 512 kilobits. For efficient memory transfers beyond the standard PEEK and POKE, PEEK$ and POKE$ enable fast block moves using 80-by-86 string instructions.

System-level access via software interrupts is a snap with the CALL INTERRUPT statement. Additionally, PowerBASIC supports writing TSRs with the POPUP statement. With POPUP, TSRs are activated via interrupts, hotkeys, the timer, or keyboard inactivity.

The in-line assembler makes including assembler code in your programs convenient. Two new related functions, CODESEG and CODEPTR, offer a way to obtain a pointer to any function, procedure, or label. Pointers can then be passed to external programs for interfacing with the code.

Arrrgh!



ISBN: 1-56276-039-4
Price: $27.95

Stuck in Paradox? Database wizard Lisa Biow's quick and comprehensive resource gives you fast access to the answers you need, so you can get back to work immediately. The exhaustive index and multilevel table of contents gives you instant access to straight answers about Paradox for Windows, from basic data entry and management to file linking and data exchange.

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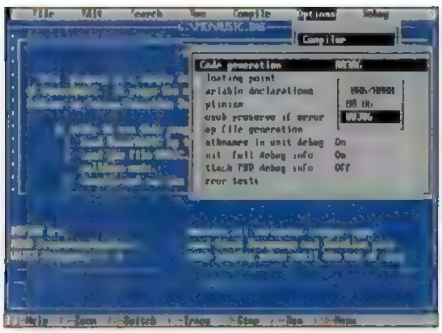

Among its many compiler options, PowerBASIC includes support for 80386 code generation.

One place PowerBASIC comes up short is its lack of bundled toolkits for such tasks as user-interface generation, charting, database management, and statistical analysis. Fortunately, a significant number of PowerBASIC-specific third-party tools are now available.

PERFORMANCE AND SUPPORT

PowerBASIC compiles programs into compact, fast .EXE files. In performance testing, PowerBASIC earned top honors in math and graphics operations, placed second in file I/O, and scored in the midrange in string manipulation.

PowerBASIC's excellent technical reference and programmer's guides and extensive on-line help delve into a lot of introductory detail on topics such as structured programming, debugging, and using the communications features. Technical support by telephone and BBS—not to mention a very active CompuServe forum—is available free of charge.

For creating DOS-based programs, PowerBASIC lives up to its name. This is an extremely capable compiler at a price that allows you to go pick and choose the added tools you need.

SUITABILITY TO TASK

PowerBASIC

	POOR	FAIR	GOOD	EXCELLENT
Professional development	●	●	●	●
Quick development	●	●	●	○
Finance and statistics	●	●	○	○
Business graphics	●	●	○	○

PC MAGAZINE EDITORS' CHOICE

FACT FILE

PowerBASIC, Version 3.0

PowerBASIC Inc., 235 Oak St., #21, Brentwood, CA 94513; 800-780-7707, 510-516-7700; fax, 510-634-0439

List price: $149

Requires: 640K RAM, DOS 2.0 or later

In short: A robust and powerful implementation of the BASIC language for creating DOS-based applications. The integrated development environment, consisting of compiler, linker, editor, and debugger, enables excellent productivity. The in-line assembler, flexibility in handling data, and blazing performance contribute to an excellent product. The package doesn't include as many additional toolkits and libraries as some others, but the low price makes this a tough bargain to pass up, especially for beginners looking to learn the language. Advanced developers can buy any third-party modules they need and pocket the difference.

491 ON READER SERVICE CARD

True BASIC Inc.

True BASIC IBM-PC Professional

BY JON BURKE

Dartmouth professor Thomas Kurtz, one of the creators of the world's first BASIC language in 1963, is back with True BASIC IBM-PC Professional Version 4.01 ($495), a heavily revamped version aimed squarely at the developer.

Available on a number of platforms, True BASIC boasts a rich language implementation, a slew of impressive libraries and toolkits, and a reasonably efficient development environment. While programs compiled with True BASIC don't exactly shatter performance records, the package is capable of addressing most if not all commercial programming tasks—if you can forgive the spotty documentation.

SUITABILITY TO TASK

True BASIC

	POOR	FAIR	GOOD	EXCELLENT
Professional development	●	●	○	○
Quick development	●	●	○	○
Finance and statistics	●	●	●	○
Business graphics	●	●	●	●

P-CODE VS. COMPILERS

True BASIC is a powerful p-code interpreter rather than a true compiler. Accordingly, it doesn't convert your source code into pure machine-code but renders it into p-code, which is a tokenized, intermediate step between the two. In addition to p-code, each .EXE file also contains the True BASIC p-code interpreter that fires up at runtime, executing the stored p-code program. This arrangement runs faster than a classical interpreter but typically slower than a fully compiled program and adds overhead to even the smallest programs.

The focus of the language implementation itself is to keep operations as simple as possible for the user. For example, only one numerical variable type exists: 8-byte, double-precision. However, True BASIC also keeps 2-byte integers internally if the data in question fits that data type. All of this remains transparent to the programmer, saving the trouble of data typing but lessening the programmer's control.

LIBRARIES AND TOOLKITS

True BASIC comes with a wide array of toolkits and libraries, almost to a fault—it's not always clear which library you need for a given purpose. For example, True BASIC is very strong on graphics and includes four different graphics toolkits: 3D, Business, Scientific, and Statistics. Even the standard graphics command set is especially rich, including such exotic primitives as Camera Angle. As you would expect from a BASIC language created at Dartmouth, matrix math is also very well-supported. Another nice feature is True BASIC's in-line support for PostScript printers, so you can take a graphic image and automatically create a PostScript output file. True BASIC also includes a B-tree indexed file-handling system for creating single-user database applications.

A real flaw is that True BASIC balks at running third-party object modules. While True BASIC can interface with code modules written in C and assembler, it can only do so if they follow special coding conventions. The unusual specification is not compatible with third-party products, so unless you plan on writing your own object modules, you can't take advantage of the wide

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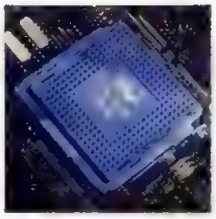

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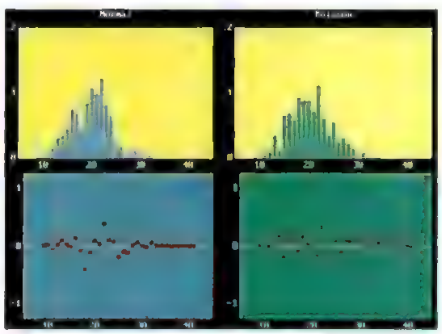
range of nifty BASIC extensions out there. This is especially a problem because True BASIC lacks an industrial-strength indexed file handler.

DISTINCTIVE IDE

True BASIC has taken its own distinct approach to the development environment. Some of its innovations are neat; others are less pleasing. The IDE's screen is split horizontally into two sections. The top half, called the source window, contains your source code for editing and review. The editor works well and has some unusually effective and slick features. For example, you can highlight a block of code and convert it to remarks or back to code again. True BASIC also supports all the normal bells and whistles, including breakpoints, watch variables, and watch expressions though with some limitations. You can only have eight watch variables and only one watch expression active at one time, for example.



A wide range of intrinsic commands and a comprehensive series of libraries make graphics one of True BASIC's best features.

True BASIC calls the lower window the command window. Here, you can enter commands to the environment to run the program, load additional libraries, or execute macros. Many of these commands are duplicated on the more traditional menu bar, but once you get the hang of it, the Command Window is fast and flexible and offers some unusual benefits. You can use it to channel trace information to the printer, for example, or execute a previously stored list of commands to personalize the environment.

DOCUMENTATION ROUGH GOING

Unfortunately, True BASIC's documentation leaves plenty of room for improvement. While the two supplied binders contain lots of detailed information, the general scarcity of actual code examples makes getting the syntax exactly right a difficult task. The documentation is not organized in any apparent order, and the index is prone to errors and omissions. True BASIC is acutely aware of the problems and has assigned the highest priority to fixing them in the next release. As it is, it's difficult to find the information you want even though it probably is included—somewhere.

Technical support quality is also mixed. In theory, True BASIC's support policies are up there with the best: 90 days free phone support, unlimited fax support, and even phone support after the first 90 days. However, what the company assured us was a temporary staffing emergency left us waiting several days for responses to our tech queries. When we did get through, the answers we received were educated and to the point.

All in all, True BASIC is powerful, easy to use, and takes a novel approach in some areas that other languages don't handle as well. The development environment is competent and the powerful command set is extended by an array of adequate—and sometimes much more than adequate—tools. It is easy to use in most applications, and it really performs in some, notably graphics. For developers migrating from competing products, True BASIC includes a utility that does a reasonable port from Microsoft BASIC to True BASIC.

These advantages are hampered by documentation and technical support problems—both of which are being addressed—and by True BASIC's inability to access different language object modules, a problem that is likely to be around for a while. If you can live with these shortcomings, this is a good, strong package to invest in.

FACT FILE

True BASIC IBM-PC Professional Version 4.01
True BASIC Inc., 12 Commerce Ave., West Lebanon, NH 03784-3808; 800-872-2742, 603-298-8517

List price: $495
Requires: 640K RAM, 4.5MB hard disk space, DOS 3.0 or later.
In short: A many-featured p-code–based system made by one of the fathers of the BASIC language. Easy to use and elegant, True BASIC offers strong graphics, a built-in interface to PostScript, and a single-user indexed file handler (B-tree). Its many bright spots are eclipsed, however, by less than lightning-like performance, problems with its documentation, and its inability to incorporate modules written in other languages. If True BASIC's many features fit all of your needs, it is a fine package. If you need top-speed execution or rely on the extra features provided by third-party sources in object module form, look elsewhere.

432 ON READER SERVICE CARD

32 Bit Software Inc.

ZBasic-PC

BY JON BURKE

32 Bit Software offers ZBasic as a three-in-one package (ZBasic-PC, ZBasic-PC/386, and ZBasic-PC/BCD) at a suggested retail price of $149.95. Even with its $19.95 add-on library, this is one of the least expensive packages reviewed. Built originally as an in-house programming tool, ZBasic specializes in some exotic tasks, notably heavy-duty serial communications. At the same time, its middling performance, spartan development environment, and the inability to call third-party object modules put this package a generation behind its competition.

STARK ENVIRONMENT

ZBasic offers an integrated development environment of sorts, but it doesn't touch the power or ease of use of today's fully integrated systems. Essentially, it consists of a clumsy full-screen editor from which you can also execute a compile.

Editing features are rudimentary at best. ZBasic supports FIND and search-and-replace, but extras such as REPLACE ALL, IGNORE CASE, and FIND WHOLE/PARTIAL WORDS just aren't there. Cut-and-paste capabilities exist, but not between files unless you resort to writing the code fragment you want to disk and then reading it back in. On-line help is minimal, and mouse support in the development environment is nonexistent.

FACT FILE

ZBasic-PC, Version 4.7
32 Bit Software Inc.,
3232 McKinney, #14, Dallas, TX 75204;
800-322-4879, 214-720-2051

List price: $149.95.
Requires: 128K RAM, 1.2MB hard disk space, DOS 2.0 or later. (386-based PC or better recommended.)
In short: This BASIC implementation lacks some of the more powerful language features, and its compiler creates .COM files only. The package's stark development environment leaves much to be desired. ZBasic-PC is recommended if you need powerful serial communications capabilities but not for large, development-intensive projects.

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The sparcity of the feature set extends to debugging. You can set breakpoints by inserting STOP or END commands into the program or by telling the environment to wait until a specified line of code executes and then check and see if Ctrl-C was pressed. But when you reach these points, you're summarily tossed out of your program and back to the editor.

Watch variables, watch expressions, and true breakpoints all are missing. The trace function merely displays line numbers directly to the screen, messing up any programmatic output that might be there.

BUILDING EXECUTABLES

ZBasic builds .COM files instead of .EXEs. The good news is that .COM files generally compile to about two thirds the size of comparable .EXEs. The bad news is that the maximum size of .COM files is 64K—including the support code that other languages optionally load into runtime modules. Additionally, the source code cannot exceed about 61K. This rather extreme limitation is somewhat offset by the fact that you can create overlays. These also cannot exceed a maximum size of 64K, but they don't need to contain extra support code. ZBasic keeps the data area separate from the program and automatically passes to overlays, so the limited program size is not as much of a problem as it seems at first. ZBasic does not support EMS out of the box, but 32 Bit Software can provide developers with a free add-on module on request.

The ZBasic package includes three separate compilers: one that uses 16-bit binary math, one that uses 32-bit binary math and generates 386 code, and one that applies the Binary Coded Decimal (BCD) convention for extra-high numerical precision (8088 code). A supplied cross-compiler can convert from 16-bit 8088 code to 32-bit 386 code. ZBasic autodetects the existence of a floating-point coprocessor and selects floating point or floating-point emulation on the fly.

When it comes to the final product, the .COM file, ZBasic's performance is spotty. In math operations, it turned in midrange test scores; in the graphics and file I/O portions of our tests, it produced the worst scores of any package tested. It did produce the best score in string manipulation routines, mainly because it is the one product reviewed that doesn't

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The weak editing functions of ZBasic's development environment suffer in comparison to other products.

support dynamic string handling. Our test of minimum useful file size showed ZBasic source code compiling to larger-than-average executables.

LANGUAGE PROS AND CONS

The overall syntax is similar to Microsoft QuickBASIC—with some notable exceptions that make conversion from QuickBASIC to ZBasic a time-consuming, manual affair. ZBasic also offers fewer variable types than most other BASICs. String handling is weak, with the maximum length of a single string set to 255 bytes, much shorter than most other languages. ZBasic does support string arrays up to the size of available memory, however. String commands such as RTRIM$ and LTRIM$ are missing from the main package, but are included in the add-on library. Other library modules offer miscellaneous graphics routines, menu design, and mouse support.

ZBasic does not support calls to external object modules or assembly code. It will let you execute in-line op-codes so that you can imbed machine language code, a labor-intensive substitute for library calls other BASICs support.

SUITABILITY TO TASK

ZBasic-PC

	POOR	FAIR	GOOD	EXCELLENT
Professional development	●	●	○	○
Quick development	●	●	○	○
Finance and statistics	●	○	○	○
Business graphics	●	●	○	○

One strong point of ZBasic is telecommunications, a field where BASIC generally does not perform all that well. ZBasic can support up to eight COM ports, although you had better have a fast machine and UART-level buffering if you want to access all of them at once. Speeds of up to 115,200 bits per second (bps) are supported.

DOCUMENTATION AND SUPPORT

The terse documentation—one manual and three small booklets covering add-on libraries—is not extensive, but it is accurate and clear. Telephone technical support is one area where this product really shines. Answers are forthcoming, the tech-support staffers—often developers themselves—are knowledgeable, and virtually unlimited technical support comes at no additional charge.

In the final analysis, ZBasic lacks many of the modern development tools you expect to see in a top-of-the-line language. At the same time, its handling of unusual problems such as multiport telecommunications make it viable, especially considering its low cost. □

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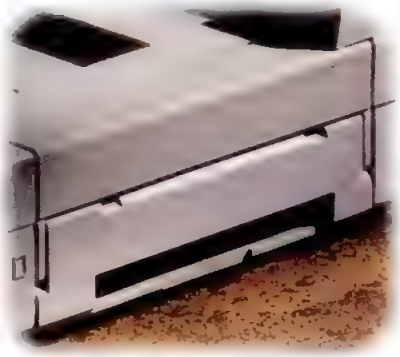

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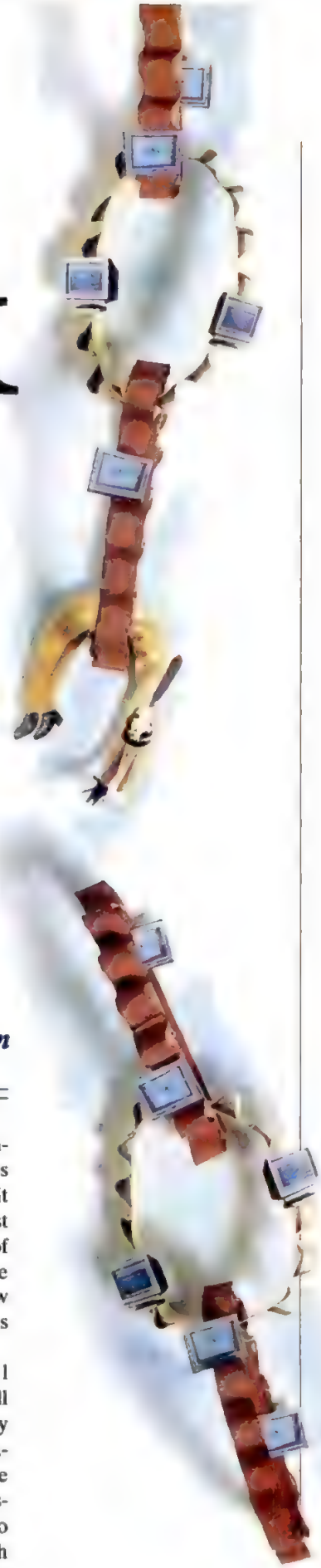
CIRCLE 211 ON READER SERVICE CARD

BACKING UP YOUR DATA

Network Backup Evolves

It's not just for disaster recovery anymore. Network backup is becoming part of a storage-management strategy that removes the weak link—you.

by Michael Peterson



Never mind that they can crash without warning. Another thing we've all discovered about networks is that they have an insatiable appetite for growth—whether through added workstations or increased disk capacity. It is this growth, as much as the ominous prospect of catastrophic failure, that drives network administrators to search for new ways of ensuring that network resources are always available to network users—and that means *whenever* they want them. Is it unreasonable for users to want access to their files and applications all the time? No, but it does mean that administrators must deftly manage the enormous contents of their networks—not just make sure there are copies around in case the things blow up. For many LAN managers, this has become a number-one priority.

Traditional LAN backup—still considered by many to be simply or principally an insurance policy against disaster—is central to maintaining high network availabil-

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Illustration by Ellen Weinstein

ity. It is an important part of an integrated file management strategy. The focus on availability has, in turn, led to an escalating emphasis on network management, fault tolerance, and system redundancy in approaches to network backup and file management.

For this roundup, we looked at some currently available network backup solutions that move network administrators several steps closer to an overall data-management strategy for achieving continuous network availability. These packages approach this goal by automating backup with an autoloader. To standardize testing, we looked for support of an ADIC (Advanced Digital Information Corp.) DAT Autochanger 1200C. We reviewed Cheyenne Software's ARCserve, Mountain Network Solutions' Mountain TapeWare, Palindrome Corp.'s Network Archivist, Legato Systems' NetWorker, and Emerald Systems Corp.'s Xpress Librarian. (This story also includes a look at an alternative solution from Intel Corp. and our observations on version 5.0 of Cheyenne's ARCserve, which was being released as we went to press. See the sidebar "Automated LAN Backup" for a comparative discussion of the products reviewed.)

These packages move the LAN manager well past the days of a disaster-centric approach to backup. That approach can hamper a manager's efforts and put today's LAN-resident, mission-critical corporate data at risk. And all of this is not to mention that the requirements for maintaining such a system manually keep the cost of managing the backup process unnecessarily high.

For LAN backup, the only process comparable to the capacity, range, and reliability offered by automation via the library/loader/jukebox strategy considered here is a PC-to-mainframe link, which a few companies do provide. (But of course, you've got to have the mainframe to begin with.)

HIGHLIGHTS

LAN Backup Automation

AUTOMATION, using sophisticated tape autoloaders and libraries, is where the high end of network backup is headed. Traditionally thought of as not much more than an insurance policy against catastrophe, network backup has recently gained prominence as a key element in the LAN administrator's complete network-management plan. Automated network backup decreases the role of the human operator—and thus the chance for human error—in almost the entire process.

NETWORKS GROW continually, whether through added workstations or increased disk capacity, leaving the LAN administrator with huge data and file storage, migration, and retrieval problems. Now, in addition to its safety-net role for today's LANs that carry mission-critical applications, automated network backup must keep track of dozens of tapes with a mix of backed-up and migrated files spanning several months in the life of a network.

THE PACKAGES IN THIS ROUNDUP are designed with automation in mind, from their required support of tape autoloaders to the way they handle file migration. They also try to make operations easy on both the LAN administrator and the users by providing familiar interfaces and clear menu structures.

TRANSPARENCY to users is essential. Administrators will design a plan, set parameters, and let the system take over, intervening only to replace a worn tape (when notified by the system) or to add a new server to the backup list. Users who lose files will simply call them up, although they won't know if they're accessing a server, tape library, or optical disk—or whether it's located in their office or across the country.

DATA MIGRATION is, next to periodic backup, the best way not only to keep your data safe but to reduce storage costs as well. Seldom-used files are moved to less-expensive (though slower) media, like magneto-optical disk or magnetic tape. Often those groomed files are kept on separate tapes right alongside the daily backup. Better backup systems not only automate the migration process, but make finding and retrieving files simple and straightforward.

USABILITY in backup software means administrators can design backup strategies and implement them from clear, comprehensible menus. Finding files for restoration should be as simple as choosing them from a list. Users should be unaware that their client machine is being backed up, and should be able to retrieve lost or deleted files without administrator assistance.

IS AN AUTOLOADER FOR YOU?

The cost of implementing backup and file management using a tape autoloader begins in the $11,000 to $15,000 range, which may seem high, but the move to such a solution is not one to be made simply on the basis of cost per MB of data. (For more information in this area, see the sidebar "Why Automate?") You should not compare a tape library or autoloader with a single-tape drive. These are different products with very different capabilities. The benefits of

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automation—cost reduction and improved reliability—are the principal factors you should consider.

Cost reduction is realized in many ways: reduced manual interaction with the backup device, media rotation performed weekly instead of daily, user-initiated restores instead of those requiring a technician, and reduced time performing file maintenance if the automated file-migration facilities are used. The cost benefits of automated file migration alone can produce a payback in less than six months. (Also note that some lower-cost alternatives that offer automation are in the works.)

Many vendors are currently providing integrated data management solutions with support for automated tape libraries, autoloaders, and optical jukeboxes. The four basic technologies used in tape devices are 8-mm and 4-mm DAT (digital audio tape), half-inch DLT (digital linear tape), and quarter-inch data cartridges. All are viable technologies for these applications, and choosing among them is difficult.

You must first consider which software solution best fits your network and your business. The library/loader/jukebox-technology decision can then be made by considering the decision criteria pertinent to your installation. Reliability, cost, service and support, capacity, compatibility, and whether a package has garnered recommendations of trusted sources should be among your considerations.

PC MAGAZINE ▶ EDITORS' CHOICE

- **Network Archivist**
- **Xpress Librarian**

Today's high-end backup software systems must offer absolute reliability, ease of use for the administrator (who may no longer have the time to change tapes manually), and retrieval transparency for the end user. In selecting our Editors' Choice recipients, we looked for products that supported either data migration or disk grooming—features that are paving the way for continuous storage management.

We found Network Archivist and Xpress Librarian easy to use, quick in their work, and able to support today's large networks. Network Archivist offers the best general automation we saw, while Xpress Librarian provides the best autoloader support of the lot. Both products excel in automated network backup, removing the LAN administrator from much of the process. Network Archivist tackles the process from every angle, handling backup, migration, scheduling, and tape labeling; the operator steps in only to move a tape off-site or replace a worn one. And even though Network Archivist's initial backup speeds are slow, its intelligent file monitoring means it can back up fewer and fewer files each time, bringing it up to speed.

Xpress Librarian's autoloader support was by far the best here. Besides changing tapes when they become filled with data, the package keeps track of which ones in the magazine are slated for backup and which ones contain migrated files. Xpress Librarian will automatically mount a tape when needed to provide a file, and it even makes provisions for a cleaning cartridge as part of the rotation.

REMOVING THE WEAK LINK: *YOU*

Network backup that requires human intervention is ultimately unreliable—in the sense that it is only as dependable as human intervention allows. The human portion of a network system will always fail at some point. Although many improvements have been made in state-of-the-art network backup, errors still get introduced with humans involved. Sometimes the system is simply inadequate for the tasks at hand. To give the point proper perspective, consider that most tape drives are rated operationally at more than 20,000 hours at 25 percent of duty cycle. This translates into less than one failure in two years of operation (at 8 hours a day, 6 days a week). Human operators not surprisingly make mistakes far more frequently.

If fault tolerance is the solution everyone seeks for higher network availability, then backup automation is the only answer for reliable data protection and management. But don't confuse backup automation with unattended backup. In unattended backup, a person still must turn the system on, change the tapes, and make sure that everything is running properly. How many times have you or your appointed staff member forgotten either to turn on the backup system or go to the server closet and change the tapes at the end of a busy day?

Backup has traditionally been driven by the need for disaster protection, but because major disasters are relatively infrequent, the focus has turned toward keeping the network and access to data available at all times. Thus, automated access to the backup or archive media fits into the fault-tolerant model.

Research continues to validate the fact that the greatest demands on the network backup media set come from single-file restoration requests: Users (or their systems) damage files, and a backup copy is required. Easy, user-accessible restoration is now a common feature of data-management software. Include a tape library, autoloader, or jukebox, and even higher levels of productivity and availability can be attained.

Backup and restore abilities, however, are only part of the equation. Today's network data management software also has file-migration abilities. The hidden costs of disk file-space management are huge in terms of user and administrator productivity loss. (A 300-node network on which users spend an average of 2 hours a week backing up and fiddling with their files can cost perhaps a million dollars a year in loss of productivity.)

Automation—which has arrived in the form of tape autoloaders, libraries,

Automated LAN Backup

by Frank J. Derfler, Jr.

An old data processing proverb says, "Your data is only as safe as your last backup." Savvy network administrators know that disk drives can and will fail without warning. Organizations that rely on networked transaction-processing applications cannot afford to lose even an hour's worth of data, and they cannot tolerate human errors. They need highly automated, large-capacity backup systems.

In this feature we review five automated tape backup packages for multiserver networks: ARCserve, Mountain TapeWare, Network Archivist, NetWorker, and Xpress Librarian. We also offer a preview of ARCserve 5.0, which has a Windows interface and improved performance, and a look at an alternative solution, Intel Corp.'s StorageExpress XLE. Each of the reviewed packages supports an autoloader to provide as much as 96 GB of on-line storage.

The price tag for these solutions starts in the $15,000 range, even for smaller networks. This includes about $11,000 just for the hardware—the Advanced Digital Information Corp. (ADIC) DAT Autochanger 1200C in our testing—and hundreds of dollars for a library of tapes. In spite of the price, interest in and purchase of these hardware/software solutions is on the rise. All of this is to say that *cost* is not the driving element in the purchase of a backup system.

Aside from reliable operation, the critical factor in selecting LAN backup software is usability. The Suitability to Task ratings focus on usability from the network administrator's perspective. (For a detailed look at our testing procedures, see "How We Tested.")

For most people, usability starts with the program's screens and displays. When you consider the megabytes in storage, it is important to be able to locate and select individual files quickly for restoration. Most of these products run as NetWare Loadable Modules (NLMs) on file servers, so the screens use NetWare's C-Worthy interface. Although it is an NLM, Network Archivist also has a helpful interface for navigating through subdirectories. Xpress Librarian and version 5.0 of ARCserve provide management programs that run under Windows on a client PC, and both have excellent utilities for finding and designating files.

Aside from reliable operation, the most critical factor in the selection of LAN backup software is usability.

The products vary considerably in where they store elements of the backup software and how the elements interact. Xpress Librarian is the only product in this roundup that runs exclusively on a client PC. This means that rather than risk loading software on each server, you can back up multiple servers running any network operating system at no added cost. On the downside, because the backup data traverses the network cable, it increases overall network traffic, and the backup software cannot access locked files.

For four of the five tested products, our test-bed used a storage device attached to one of three file servers. Xpress Librarian, however, runs from a client PC; its autoloader was attached to one of the clients, and it had the longest backup time.

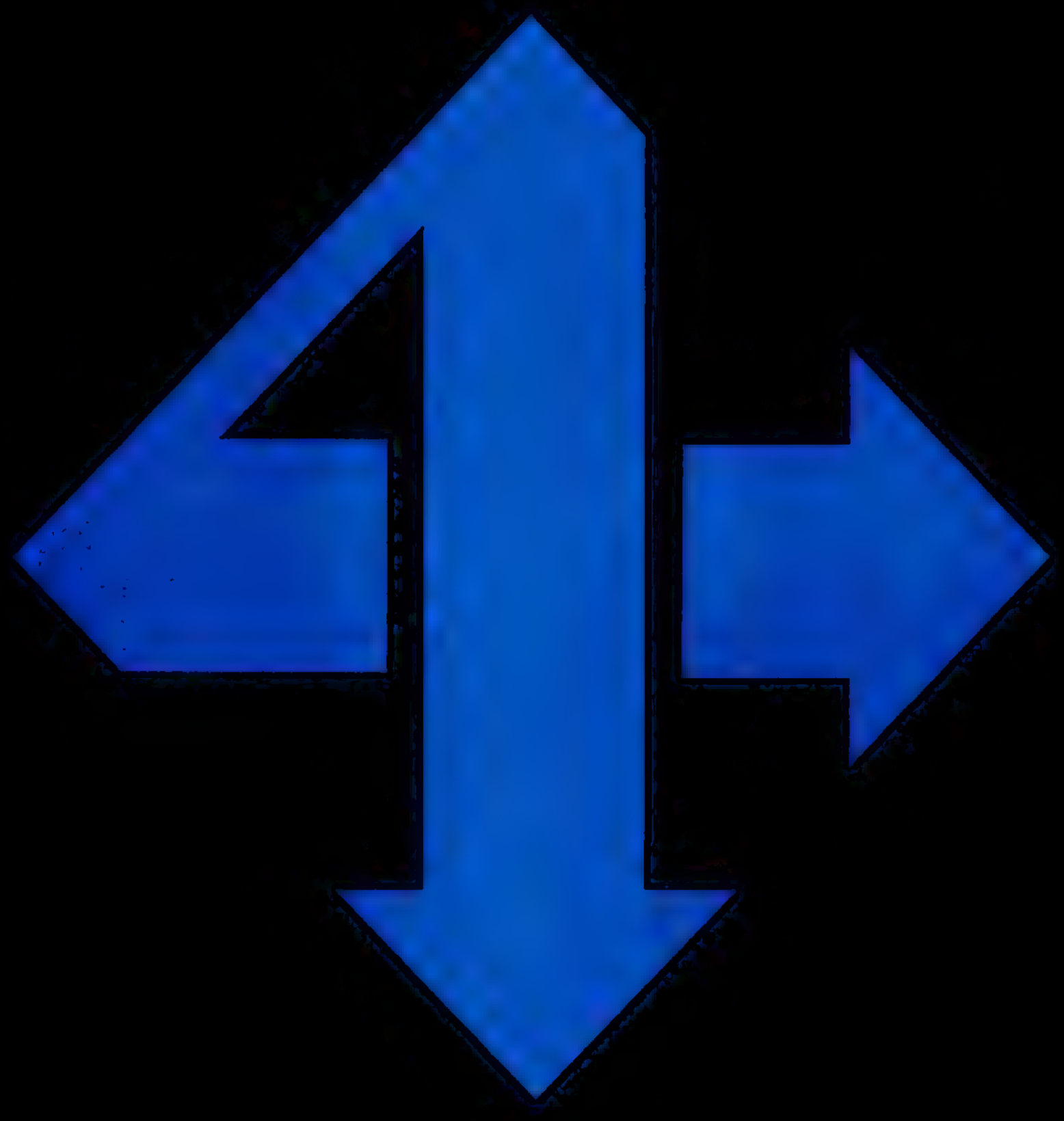
The other products run in a distributed mode. That is, programs running on different servers or client PCs send data to the main program running on the computer attached to the tape storage system. If the storage system is attached to a file server, the network traffic is kept to a minimum, and greater speed is realized. The designers of ARCserve and of Network Archivist were able to increase throughput across the network by moving data in 1,500-byte packets instead of NetWare's usual 512 bytes. (See "How We Tested.")

You can run the NLM-based products on an active file server or on a PC set up as a dedicated backup server using Novell's runtime version of NetWare. Many administrators set up a separate backup server, following the simple logic that "if the file server holding the restore software is down, then backup tapes don't do you any good."

Administrators of large NetWare networks will be interested in NetWorker's tight integration with Novell's SMS (Storage Management Services). An SMS module is also an option under ARCserve. SMS is Novell's set of programming interfaces and standards that attempts to mask the differences between the various kinds of storage media, drives, and adapters and to provide backup products with various file-related services from the network operating system. SMS is in its infancy, but it promises simplified and efficient operation.

NetWorker is also unique in its ability to use slices of time from the servers instead of running backup activities in a batch mode of operation. This makes backup a continual process instead of a sometime thing.

Your choice of backup software will probably be driven by the level of automation offered (after the initial setup, how much will you need to do?); by how easy it is to set up the backup procedures and the rules you want to use; and by how seamlessly it integrates with NetWare. □



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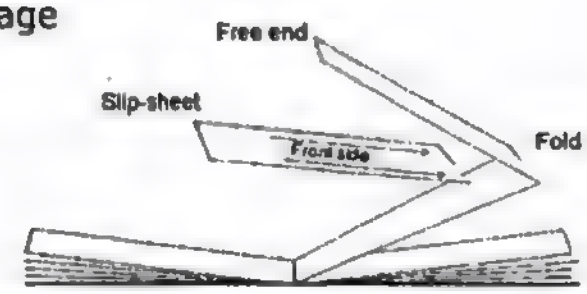

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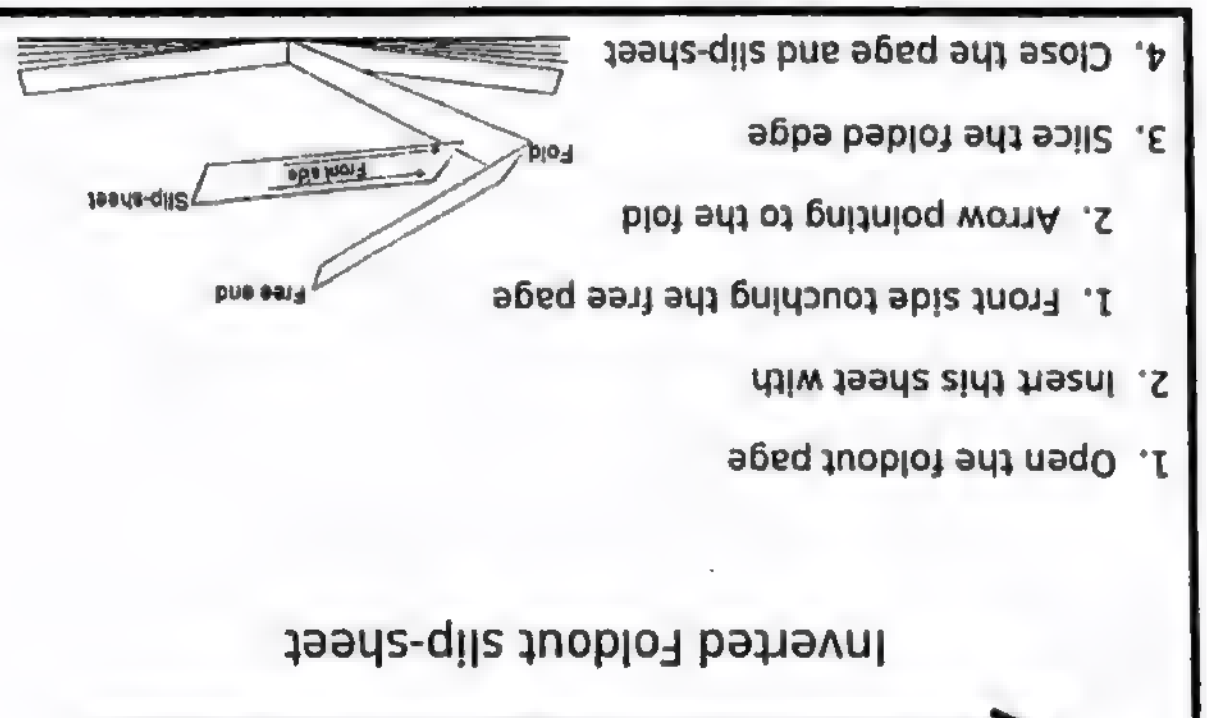

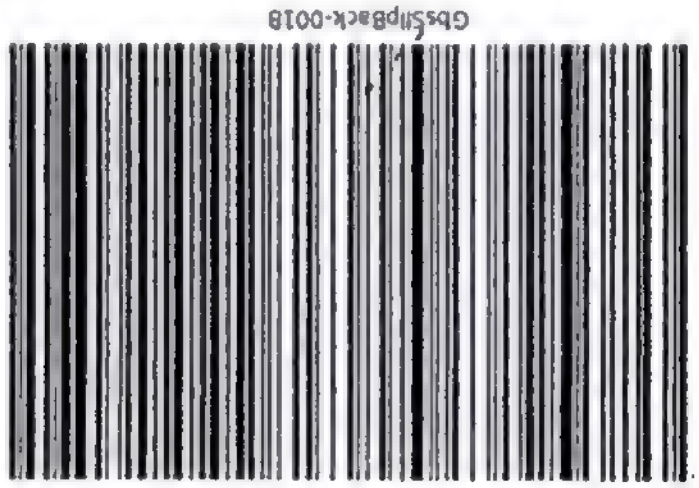

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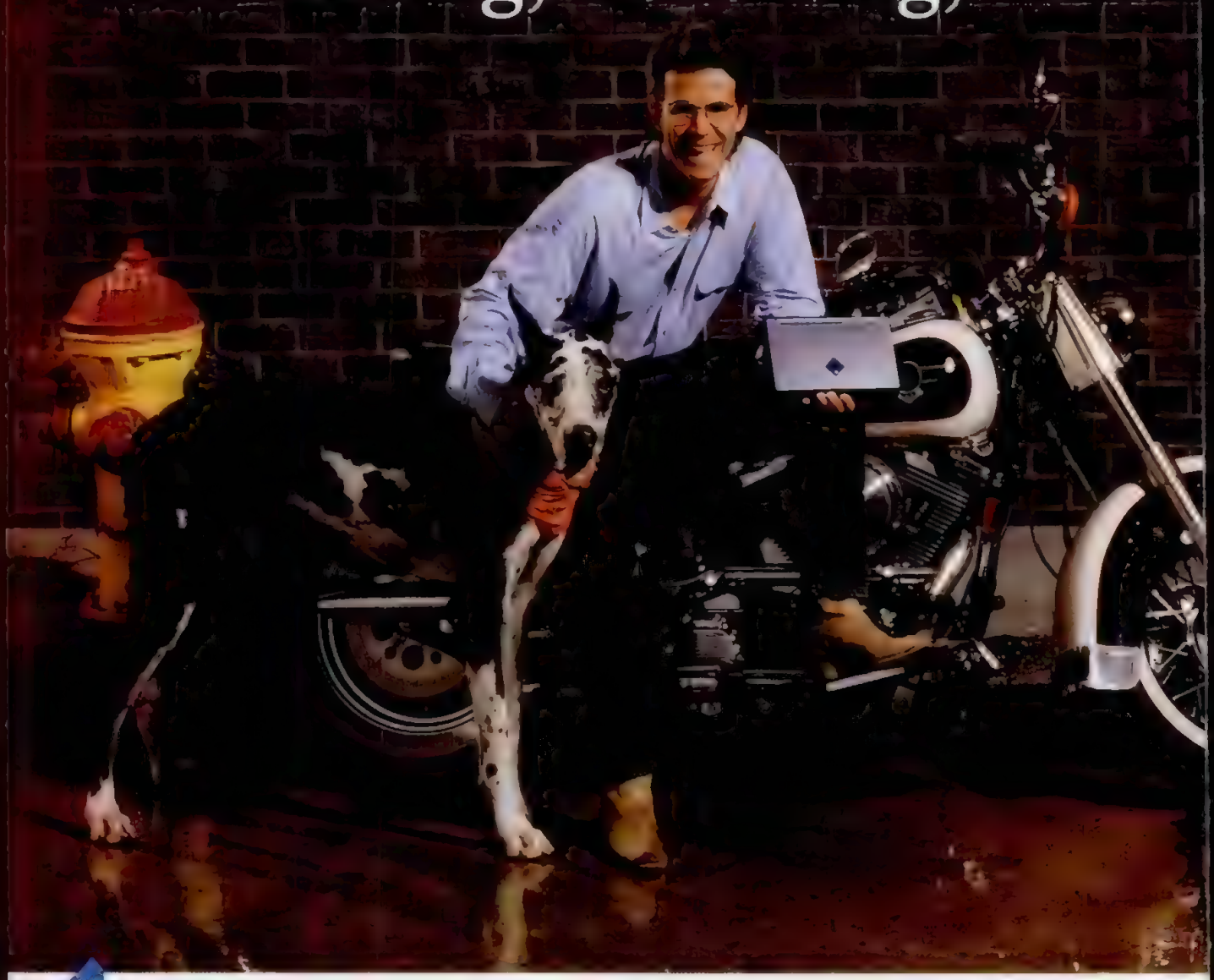

"You'll have to pry my cold, dead fingers off to get it away from me." That's what an editor told us once about the Gateway 2000™ HandBook we sent him for evaluation.

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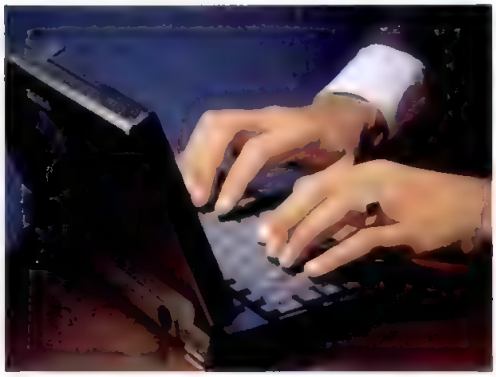

Even though the HandBook is very small, it has an excellent, touch-type keyboard. You'll also appreciate the sturdy, heavy-duty plastics used in the case.

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FEATURES

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Suitability to Task
For today's automated network backup, some traditional features remain as important as ever, even as new ones gain favor. We looked for a good combination of both, noting backup and restore functions, automation capabilities, and well-designed menu structure.

Menu operation Good menu structure is critical in controlling backup and restore processes. A well-designed menu will let the administrator easily back up all a network's servers, offer scripts to customize and automate an operation, and support script-queue management. The menu should also allow users to tag single items (such as the Bindery file), and ought to include options for controlling tape management and tape formatting, reading labels, mounting and unmounting tape media, and reporting of available storage room on tape.

Automation How far does the product go in automating the backup procedure? Packages that offer efficient unattended backups scored higher than products that require more administrator intervention. We looked for the ability to offer standard script templates, browse network resources (such as servers, volumes, and directories), import commands into the script, and control scripts in a queue for, say, setting priorities and deleting or adding scripts. We also tested the packages' utilities for editing script profiles

SUITABILITY TO TASK

Product Name	POOR	FAIR	GOOD	EXCELLENT
Menu operation	●	○	○	○
Automation	●	●	○	○
Backup features	●	●	●	○
Restore features	●	●	●	●
Remote DOS backup	●	●	●	●
Mac file support	●	●	●	●

Backup features We tested the relative strength of the backup software on a multiserver network. The best packages not only offer a wide range of backup techniques but can be automated and customized as well. The backup utility should be able to back up the entire server, offer incremental and differential backups of files that have changed, and migrate unused files from the server—all with little user intervention. Also, it should let the administrator base backups on file extensions (.EXE, .COM, and so on), relative and specific dates, and file sizes. A package should create a report for each backup, verify data as it is written, and offer a preview of a file that is to be backed up.

Restore features We tested how easily the administrator can search for and restore files that have been backed up. We ran a single file search over a series of tapes and a single search over a group of files. We looked for the ability to restore the selected file to the proper location, and we compared the integrity of the restored file with that of the original. We also tested entire directory restoration (including all files and their related attributes), as well as the integrity of the Bindery after a restore.

Remote DOS backup We looked at the basic but always important ability to back up and restore a client PC connected to the network.

Mac file support Backup software must be able to handle the Macintosh file format. We added a Mac client to the network and copied a variety of files from it to the server. We then backed up and restored the Mac files, testing to see if the correct naming system was restored and noting how easy the process was to perform.

and optical jukeboxes with software that solves these problems—is the only way to minimize human interaction, reduce operating and management costs, and improve network availability.

The class of tape autoloaders and software solutions described in this article provides much more than high-capacity backup. Media rotation can be automated, removing the need to label, track, and mount a fresh tape manually each day. Concern about management of media rotation is a primary reason many administrators implement full backup systems rather than incrementally based systems. Yet with the time available to perform full backups constantly being reduced, the choice is either to continue to add more tape drives (and further complicate the backup system and management) or to add an autoloader or library and implement media rotation.

An automated system that has all the incremental backup media on-line all the time addresses most concerns. Users can access the system through the file-history database so they can perform their own restores. No longer do they have to wait hours for a technician to find the tape, mount it, search for the file, and transfer the file to their location. Files can be copied, shelved, and migrated off hard disk storage to other (nonbackup) cartridges in the library as they meet criteria established by network administration. This frees up valuable hard disk space and places the files in a *near-line* repository where the user has easy access to them if they are needed again. (For more information in this area, see the sidebar "Why Automate?")

STORAGE EVOLUTION

Backup for PC LANs began with simple software that evolved from single-user applications through the addition of capabilities for backing up and restoring the network's hidden read-only files. In Novell's NetWare, these are typically the network securities, binderies, and trustees. This class of backup software is called *network-aware*.

When the ability to transfer data across the network is added, network-aware software becomes *network backup* software. Such software provides support for multiple servers and clients to back up to a single target drive. Today, network data management backup software is distinguished by features such as a *librarian* (a file-history database maintained on hard disk) and file migration. Data management software manages data and files, not just backup.

Our graphic "The Evolution of LAN Backup Software" illustrates how LAN backup software is likely to evolve. The ultimate objective is an environment (enabled by the network operating system) in which storage and all storage devices are transparently managed as an integrated part of the network (called *system managed storage*).

Storage management is an apt descriptor for the many applications that will reside in the network to manage storage devices, performance, and the storage hierarchy. They will operate continuously in the background, providing network services and resources. They compare with today's backup applica-

tions, which turn on, run serially, and then turn off.

As this article was going to print, Avail Systems Corp. was announcing Avail-Stor, an enterprise-class hierarchical storage management (HSM) solution for NetWare networks that automatically migrates less-frequently used files to low-cost optical jukeboxes and tape libraries. Conner Peripherals, the first OEM of the technology, was introducing the Conner HSM System in the same time frame. The package enables businesses to establish a cost/performance hierarchy of storage devices and allows users to access migrated files automatically and transparently.

Our graphic "The Evolution of LAN Backup Hardware" shows how backup and storage management hardware tracks with the evolving software. In the early going, as more capable software became available, single-tape drives were coupled into multiple-drive systems. The ability to manage backup to multiple drives in parallel speeds the backup process considerably and lets network administration retain control of the process.

In 1991, libraries, loaders, and jukeboxes for LAN backup and file migration appeared on the market, and, in 1992, the migration path changed. Integrated systems using dedicated server-class computers and high-performance storage devices were introduced as application servers that sat on the network backbone and provided network resources.

Backup servers provide centralized backup, restore, and file-migration resources to the network. They typically run data-management software and have a large dedicated hard disk with multiple tape drives or a library/loader attached. True storage servers will soon enter the LAN market. A storage server appears to the network as a very large addressable storage resource; it provides both large disk capacity as well as an optical jukebox and/or tape library. A number of storage-management applications run continuously on the storage server managing network storage transparently.

AUTOMATION FORECASTING

The market for libraries and loaders in the LAN environment is relatively new, with 2,500 units shipped in 1992. Of these, 1,300 were 4-mm–based and 900 were 8-mm–based. ADIC and Exabyte Corp. are the two dominant vendors (see our chart "Worldwide LAN Autochanger Shipments" for more details in this area). The forecast for 1993 has grown to 13,400 units, largely because the autoloader was introduced midyear. Using 4-mm DAT technology, Conner Tape, Hewlett-Packard Co., and WangDAT are among the first to introduce a 5.25-inch box that contains a 3.5-inch drive and a magazine holding four to six DAT cartridges.

These small boxes, which can mount internally in a server, promise to deliver

Glossary of Network Backup Terms

archive To remove files from primary storage to off-line media when they are no longer required by users—a process also known as *retirement* or *shelving*. The media are placed in a repository where they can be recovered, if necessary, after an extended storage period. Files are typically archived after several redundant backup copies have been created. Another definition, used in context with *file migration*, is to move files off primary storage and to place them on less-expensive near-line or off-line media where they can be moved up the storage hierarchy if necessary. (In the mainframe world, to *archive* is to copy files onto secondary media as a means of assuring that redundant copies exist.)

autoloader A storage subsystem that uses magazines holding multiple tape cartridges. Either a magazine moves its tapes past a stationary drive head, or a movable drive head is moved along the magazine. Also called a *loader* or *stacker*.

backup automation The removal of human intervention, to the extent possible, from the network backup process through specialized hardware and software. Automating periodic network backup reduces the chance of failure that human operators can introduce. Backup automation is generally part of an overall data management strategy to keep the network available to users at all times. This is not to be confused with *unattended backup*, in which someone must still turn the system on, change the tapes, and assure that the system is configured and running properly.

concurrent backup The backup of files from multiple sources (servers or workstations) to a single target (tape or optical disk, for example). The objective is to keep the target drive recording data as fast as it can take it. The data from each source is interleaved on the backup medium with block-level markers and pointers identifying the source.

file migration The transfer of files from a high level of the storage hierarchy, such as a server's hard disk, to a lower level, such as tape or optical disk, based on preset criteria of file usage. Inactive files are moved to the slower, less-expensive medium. The IEEE Mass Storage Reference Model refers to the reverse operation (the recovery of stored files) as *retrieval*. Also see *grooming*.

grooming The transfer of files from high to lower levels of the storage hierarchy, accompanied by optimization of the server's volume through disk defragmentation. This process is similar to file migration but more extensive

jukebox A storage subsystem that uses pick-and-place robotics to place optical disks into one or more drives automatically.

library A storage subsystem that uses pick-and-place robotics to place tape cartridges into one or more drives automatically.

network data management The management of files for backup and archiving across multiple network servers and clients. The term also describes a class of comprehensive network backup software that includes file-history databases and file migration capabilities.

parallel backup The simultaneous copying of files from multiple sources, such as network servers or workstations, to multiple targets. Individual sources write data to individual targets, but those multiple events take place simultaneously under centralized control.

storage management software The class of software that manages storage devices, the storage hierarchy, and functions related to the location of files and the methods of determining file backups and transfers. Many of these packages also handle data management functions.

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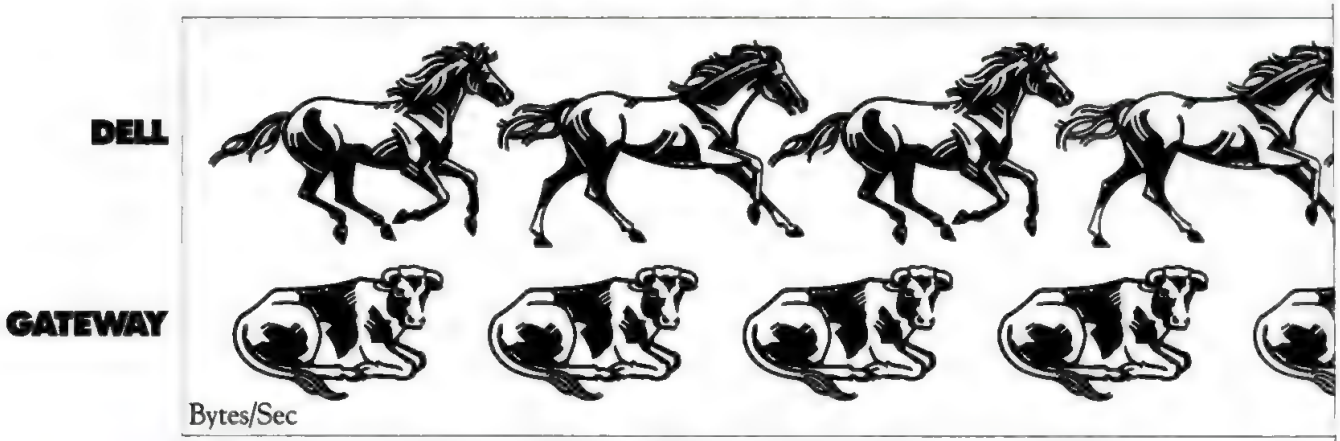

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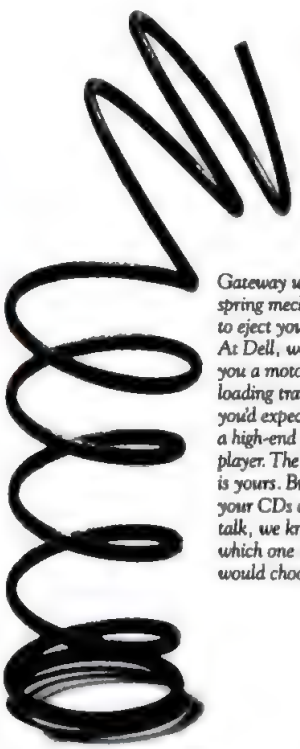

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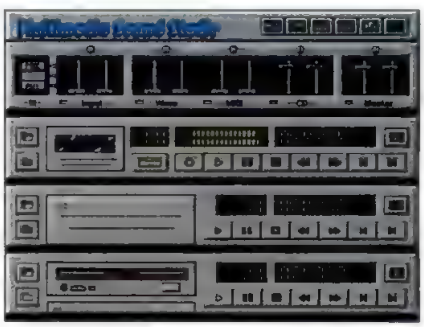

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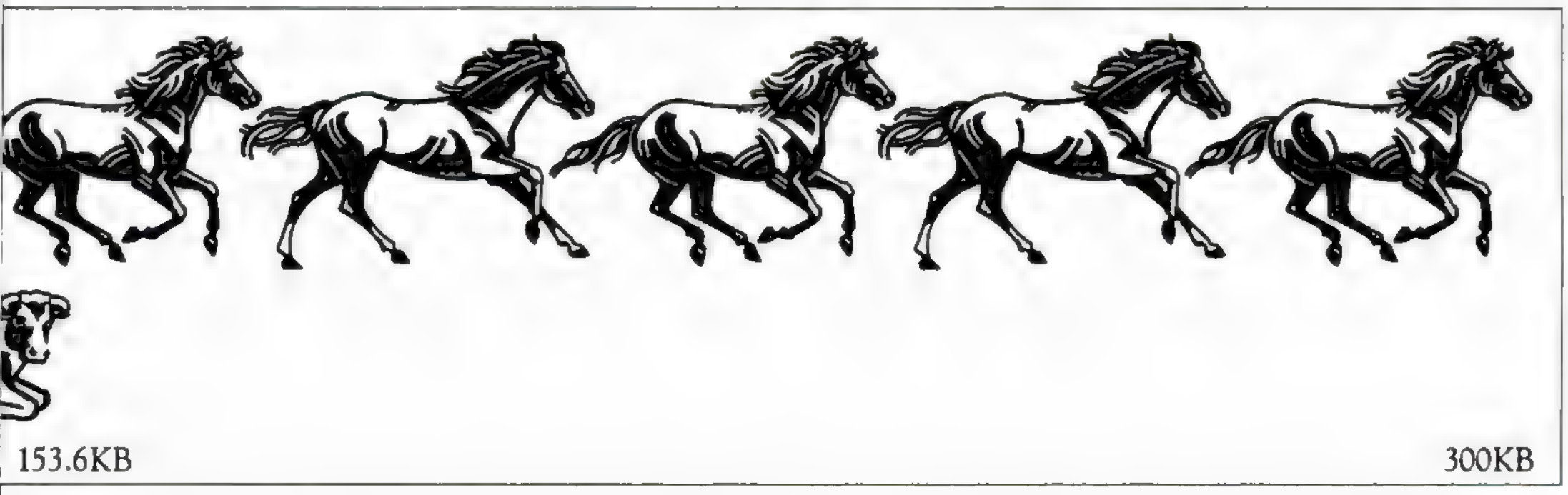

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Source: Gateway 2000 Customer Support Guide Rev. #3, page 4.

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low-cost automation capability to every network. When combined with the new 4-mm DAT drives that have double transfer rates, the performance (386 to 500 kilobytes per second) and capacity make these very attractive solutions for automation.

No single tape-drive technology runs away with the library/loader/jukebox market. Each has its own assets and applications that it best fits. And companies are in the process of enhancing each with significant improvements in the areas of performance and automation compatibility. This "next generation" of network-backup products will begin to carry network data, file, and resource management into the future.

Cheyenne Software Inc.

ARCserve

BY CHARLES P. KOONTZ

Cheyenne Software's ARCserve, Version 4.0, is a client/server application with the server module and a tape driver residing on a NetWare file server. We tested the optional tape-changer module rather than using the standard tape driver. The client-manager software typically resides on a workstation but can be installed on a network drive as well. In either case, it runs on a client PC.

SUITABILITY TO TASK

ARCserve

	POOR	FAIR	GOOD	EXCELLENT
Menu operation	●	●	●	●
Automation	●	●	●	○
Backup features	●	●	●	○
Restore features	●	●	●	○
Remote DOS backup	●	●	●	○
Mac file support	●	●	●	○

(Cheyenne released ARCserve, Version 5.0, too far into our editorial cycle for us to conduct a formal review. We did, however, look at a late beta version. In addition to the capabilities noted here, the new release provides a Windows interface for the management module, offers improved autoloader and file-migration support, and gives the system the ability to back up to seven destinations—tape drives, servers, optical disks, and other media—simultaneously. Version 5.0 also adds Storage Management Services [SMS] support and makes it easier to select files and clients for inclusion in the backup process.)

ARCserve ships with workstation agents for DOS, OS/2, and Windows to back up local workstation drives; Version 5.0 includes agents for a wider variety of operating systems.

Installing ARCserve is a snap. After you have copied files to a client PC, the installation routine handles almost everything—though a user needs to make agents available to each client.

ARCserve's Quick Start option will back up your entire network while you read the manuals, automatically selecting all servers on the network and all workstations it can find. (Of course, it can only find workstations that are running the agents.)

ARCserve relies on a grandfather-father-son backup scheme based on a seven-day week with daily differential or incremental backups, a full backup at least once a week, and monthly and annual backup tapes. Beyond letting you choose the day of the full weekly backup and the type of daily backup, Version 4.0 doesn't offer much choice in the operations. (Version 5.0 is more flexible and includes scripts that allow more customized backup.)

ARCserve's C-Worthy interface will be familiar to most NetWare users. Specifying servers, volumes, directories, and files for backup is flexible and simple. The client-manager software schedules jobs in three different ways. The AutoPilot function adds the greatest amount of automation; unattended operation schedules jobs for specific times, and attended operation handles things interactively. ARCserve uses the tape autoloader mainly as a replacement for a human operator when changing tapes (although Version 5.0 adds file-migration support). ARCserve can also provide unattended copying from one NetWare file server to another (instead of to a tape drive) at periodic intervals.

ARCserve's AutoPilot lets administrators choose among several backup strategies.

Backing up workstation local drives works without having the client PC logged onto the network as long as IPX (Internet Packet Exchange) and the ARCserve agent are loaded.

ARCserve tracks which clients are backed up to which tapes. Its quick file-access database allows wildcard searches for filenames within a given tape even before you mount it, but it does not allow wildcards to be used during backup. You can pick the file you want from the list that matches the wildcards. If the tape containing the file is already in the changer, ARCserve mounts it and retrieves the file—another feature that makes the restoration process faster.

FACT FILE

ARCserve, Version 4.0

Cheyenne Software Inc., 3 Expressway Plaza, Roslyn Heights, NY 11577; 800-243-9462, 516-484-5110; fax, 516-484-2489

List price: Up to 5 users, $395; 6-20 users, $1,195, 21-50 users, $1,495; 51-250 users, $1,895. Workstation agent, $495-$695; changer option, $1,195; SMS agent, $100; stacker option, $695; database agent, $495-$4,995

Requirements: Server: 4MB RAM, 4MB hard disk space, NetWare 3.1*x* or later. Client: 640K RAM, 3MB hard disk space, DOS 3.*x* or later. NetWare-compatible LAN card: SCSI or QIC-02 tape drive, IPX 2.1*x* or later.

In short: ARCserve is an intuitive package that provides strong backup features for DOS, Macintosh, OS/2, and Unix files. Its few problems are corrected in the new version, due out by the time you read this.

441 ON READER SERVICE CARD

SMS is optional with ARCserve, though we didn't use SMS in our tests. Nevertheless, ARCserve restored the NetWare Bindery and access control.

We did find two problems with this otherwise easy-to-use product, both of which appear to be corrected in Version 5.0. First, Version 4.0 cannot handle directories deeper than 16 levels. And second, when asking Version 4.0 to back up a large number of files, we found that its lack of memory management caused it to chew up RAM—so much so that errors popped up even after we aborted the process. Large indexes of backed-up files could cause the same result.

Those points noted, Cheyenne's documentation does follow its software organization very well, and includes installation sections for NetWare 2.*x* and 3.1*x*. The documentation does fall short of explaining the connections among all the different parts of ARCserve, however. It almost seems as if it used to be several applications, and the manual had yet to catch up with their integration into the system.

The most important missing piece is documentation for the tape changer, which is a problem since it tends to generate some cryptic error messages. Without a manual, for example, how can you know that "Failed to Contact Tape Driver—UDE" may mean that you have a bad tape loaded?

ARCserve has held its favorable position in the market for a reason. Version 4.0's easy setup and well-designed scheduler, backup, and restore procedures are evidence of the thought and testing Cheyenne has invested in this product. Version 5.0 corrects the problems this release carries and adds to an already robust feature set.

Mountain Network Solutions Inc.

Mountain TapeWare

BY PADRAIC BOYLE

If security is a major concern in your quest for a network tape-backup system, Mountain Network Solutions' Mountain TapeWare, Version 4.10, will fill the bill. With an intuitive interface and a low price to boot, Mountain TapeWare aims for the hearts of the more careful network administrators. It falls somewhat short, however, with its lack of support for NetWare SMS (Storage Management Services) and its poor file grooming and migration—both features that are essential to a fully automatic backup solution. And Mountain TapeWare's management features, though powerful, may be difficult for the backup novice to use.

Why Automate?

It's a reasonable question. Why should you spend $13,000 to $40,000 for a fully integrated system? Think of all the tape drives you could buy for that much money!

But consider the alternatives more closely. If your storage capacity and file migration needs are pushing you toward buying more and more tape devices, who is going to manage all that equipment, and who is going to pay for the time it takes? As your network grows, the management task grows exponentially, and along with this growth come the hidden costs of storage expansion—hidden because companies do not often have cost-accounting systems in place to calculate them. But as long as these storage costs are distributed and hidden, management pressure to automate remains low.

In an international study, Peripheral Strategies, a market research firm specializing in storage management, has been analyzing these costs to gain perspective. Preliminary analysis indicates that the costs of managing backup, restore, and archive functions range from tens of thousands to hundreds of thousands of dollars every year, depending on the size of the network. Nowadays it's not unusual to find companies spending $50,000 or more each year to purchase new hard disks in order to handle capacity expansion.

But the biggest revelation comes when you look at what the cost is in terms of user productivity, as individuals struggle to manage their local file space. Most companies with more than 300 connected computers are reporting productivity losses in excess of $1 million per year. The real opportunities for productivity gain—and cost reduction—come from incorporating client PC support into a total storage management system.

By acquiring a library-, autoloader-, or jukebox-based data and storage management system, you can greatly reduce the cost of these activities. Not only is there rapid payback from a cost-justification standpoint, but reliability of the system is improved tremendously.

Corporate data is critical and must not be lost because of human error. Uniform policies and practices must be put in place using fully integrated software and hardware solutions, such as those presented in this roundup. □

Backup Automation Benefits

- Reduced management costs
- Automatic media management
- Higher storage availability and reliability
- User-initiated restores and retrievals
- Greater productivity
- Automated file migration
- Reduced storage expansion costs
- Capability for extension to other storage management applications

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PC MAGAZINE EDITORS' CHOICE 1989-1993 LANtastic 5.0 May 25, 1993

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Mountain TapeWare (which is licensed from Emeritus Technology), approaches network backup differently than its competitors, operating as a virtual network consisting of servers and clients. It grants system access to these devices through a security system similar to that of NetWare's Bindery but independent to the operating system itself.

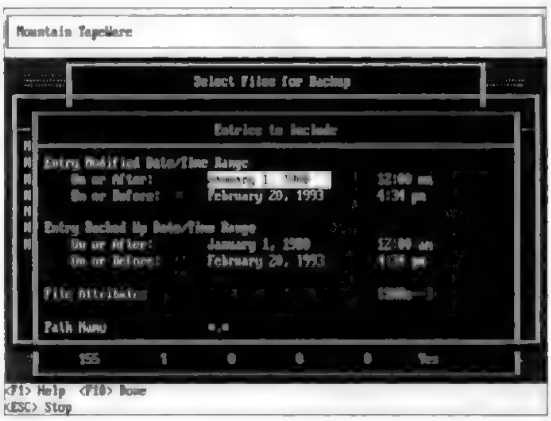
SUITABILITY TO TASK

Mountain TapeWare

	POOR	FAIR	GOOD	EXCELLENT
Menu operation	●	●	●	●
Automation	●	●	●	●
Backup features	●	●	●	●
Restore features	●	●	●	○
Remote DOS backup	●	●	●	●
Mac file support	●	●	●	○

Mountain TapeWare's central operation control is kept in a series of libraries stored on one or more servers. Access to the devices on that network is achieved using a Mountain TapeWare File System Agent (FSA), which runs on Ethernet-connected devices to allow peer-to-peer–like access to servers and clients. The backup administrator can scan and tag files and directories for backup and restore procedures. Mountain TapeWare can schedule operations to be performed during off-peak hours and can run procedures automatically through scripts stored in its libraries.

Mountain TapeWare provides FSAs for DOS and OS/2 clients and NetWare, Versions 2.*x*, 3.*x*, and 4.0, servers. The autoloader option is available for NetWare 2.*x* as a VAP (value-added process), for NetWare 3.*x* and 4.0 servers as an NLM (NetWare Loadable Module), and even for DOS as an executable file (to attach the autoloader to a client PC). Mountain TapeWare is the only backup package we tested requiring that all servers run a VAP or an NLM in order to be accessed by the tape system.



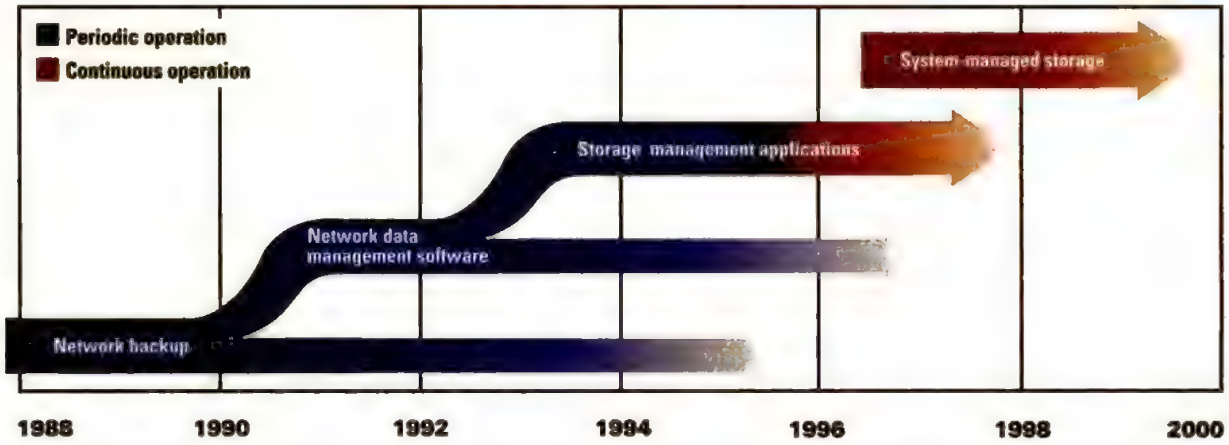
Mountain TapeWare lets administrators choose files for backup by last modification date or last backup date.

Mountain TapeWare stores files called *instances* on several backup tapes, each containing a different version of the file. This is similar to Network Archivist's backup method and gives an administrator the ability to restore the most recent version of a saved file or an older version. In the event the file has been corrupted and is also corrupted on the latest backup, clean older versions are (most likely) available, although recently added data will have been lost.

Mountain TapeWare comes complete with its own BASIC and macro languages to allow customization of user menus and system operations. Administrators can program their own special menus, which can be executed either on the command line or via keyboard macros. Some administrators will like the flexibility of being able to set up backup procedures on their own, but some may decide it adds potential for confusion. Moreover, an improperly written program could lead to data not being backed up correctly. Mountain TapeWare does provide extensive documentation, including a reference for all the BASIC commands and error codes.

Mountain TapeWare's security is head and shoulders above its competitors'. Based on NetWare's security system, Mountain TapeWare lets the administrator configure the backup network with users and groups bearing rights to devices within. The supervisor has rights to oversee all of the devices throughout the network, the same as in NetWare. Trustee rights may also be assigned to users or groups as restore only, backup

The Evolution of LAN Backup Software



Though traditional network backup software will continue to be a solution in some networking situations, sites with mission-critical applications on LANs are moving toward continuous data management software.

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An Answer From Intel

by Padraic Boyle

Wouldn't it be nice to have a tape backup system that would not only back up your network servers and clients but also rotate and format tapes, groom unaccessed data files, and even print a label for the tapes—all without user intervention? Intel Corp. delivers just that with StorageExpress XLE, a $13,495 system that includes a backup server, tape drives, and software.

StorageExpress works on the principle that backup procedures should be automated as much as possible. This focus, combined with its ease of use, good security, and support for Novell's SMS (Storage Management Services), makes StorageExpress XLE a strong contender in the heated-up network-backup market. (One drawback, however, is that it cannot restore directly to a client PC.) StorageExpress was not included in our main review because it lacks the autoloader support we were looking for, but it has a parallel solution in its support for its own tape units.

StorageExpress XLE comprises three units: the control unit, the peripheral unit, and the Central Console. The control unit has its own processor and hard disk and sits on top of the peripheral unit. Using NetWare runtime software and optional attachment ports, it is the server portion of a client/server relationship, as well as the brain behind StorageExpress XLE.

The peripheral unit houses one to four 4-mm or 8-mm units, depending on your needs. Several peripheral units may be daisy-chained to offer more storage capacity.

One Central Console package can control several StorageExpress units, and directs, among other tasks, remote configuration, configuration changes, tape formatting, and backup scheduling. Its Windows interface makes navigation through the program easy.

StorageExpress XLE is one of the first tape backup systems to support Novell's SMS. This allows it to back up Macintosh, OS/2 FAT and HPFS, NFS, and OSI/FTAM name spaces on a Novell server. Most other storage companies plan to follow suit.

CHOICES

StorageExpress XLE offers three types of backup procedures. The Streamline backup option is a daily routine with a built-in GFS (grandfather-father-son) tape-rotation scheme; it backs up all files one day a week and then backs up only the changed data every day in between.

StorageExpress XLE is based on the idea that backup procedures should be as automated as possible to free network administrators.

In the GFS scheme, the *son* is the daily backup of the changed files, generally duplicated on four different tapes. The *father* is the tape with the full data backup for the week, three duplicate copies of which should be rotated between on- and off-site locations to keep data safe but accessible. The *grandfather* is the monthly tape that contains a full system backup; this tape should be put into permanent storage.

Both clients and servers can be backed up using the GFS option. Tapes are automatically rotated, formatted, and named, and—if a Seiko Smart Label Printer Plus is attached—a label is printed for them. Grooming, or data migration, is also available for servers backed up using the Streamline option. Unfortunately, this is the only option that supports both the GFS scheme and client backup. Custom, another backup method offered, is only for server backup use. It requires some user configuration, using the Windows interface to choose files from a server. Files may be marked for deletion after backup, and passwords can be set on the tape for security. Custom is also more configurable than Streamline.

The third option, a function unique to StorageExpress XLE, is the Tape-To-Go backup option. Tape-To-Go allows administrators to save data to a tape and then use that tape on a StorageExpress XLE unit on another network—because no entry is made in the File Tracker database. A merge is used to link the tape with the new database. Although a potentially useful feature, it could prove to be something of a security breach if administrators and users are not careful about the use of sneakernet to move the tapes.

The client backup is simple to set up, but it has two operational quirks: You cannot restore directly to a client PC without first restoring to a server volume and then copying files to the client; and, although StorageExpress XLE can back up DOS, Windows, and OS/2 clients on a network, it can do so only under the Streamline option.

Intel provides excellent technical support, from 10 A.M. to 2 P.M. eastern time. All hardware comes with a one-year warranty and 48-hour parts replacement. Easy-to-follow instructions walk you through the installation process, and troubleshooting flowcharts are available for solving some problems.

For a package that offers good security, SMS support, ease of use and a complete, easy-to-configure automated network backup solution, take a look at Intel's StorageExpress XLE. Although it cannot restore to a client PC, it does offer a good solution for network backup. □

FACT FILE

Mountain TapeWare, Version 4.10

Mountain Network Solutions Inc., 360 El Pueblo Rd., Scotts Valley, CA; 800-458-0300, 408-438-6650; fax, 408-438-7623

List price: Up to 5 users, $299, 6-20 users, $699, 21-50 users, $999, 51-100 users, $1,299, 101-250 users, $1,699 FileSafe Data Bank autoloader, $9,995

Requirements: Server: 512K RAM and 384K RAM per connected tape device, 2MB hard disk space plus space for backed up files, NetWare 3.11 or later, Novell CLIB, Revisions A, B, or D. Client: 21K RAM, 2MB hard disk space; DOS 3.1 or later, IPX, Revision 3.10 or later, NETX, Revision 3.26 or later

In short: A low price and intuitive interface make Mountain TapeWare a bargain, though its lack of SMS (Storage Management Services) support and weak file-migration facilities are definite drawbacks. And its powerful macro language, though useful for experienced administrators, may be daunting to users new to the backup process

442 ON READER SERVICE CARD

only, display subdirectories only, or a combination of all three.

Thanks to its quick searches, Mountain TapeWare performed admirably in performance testing, scoring just below ARCserve.

Where Mountain TapeWare falls somewhat short, however, is in its lack of support for data migration and grooming, which can extend the life of a server's volume. For example, Mountain TapeWare will not back up a file if several copies already exist; it eventually will archive the file, but that's it. Other products offer more-automated grooming procedures; some, notably Network Archivist, watch file usage carefully for just that purpose. But some administrators may view automatic periodic grooming as not particularly useful and may prefer instead to install a larger hard disk into a server to avoid conflicts with their end users (who may not want to wait to retrieve an old file from tape).

In sum, Mountain has designed a highly secure tape-backup solution with an easy-to-use front end—and kept the price down. But some of the additional features could introduce confusion for administrators unaccustomed to programming. That, combined with the package's lack of SMS and data-migration support, could keep it from being a first choice.

Palindrome Corp.

Network Archivist

BY PADRAIC BOYLE

Palindrome Corp.'s Network Archivist, Version 2.0, takes the work out of backing up a network. Scheduling backups and figuring out when to rotate tapes and how to label them are things of the past with Network Archivist, which handles all that automatically. With excellent data protection and migration, as well as an easy-to-use interface, this is a product for both new and experienced LAN administrators.

Network Archivist is a rule-based package with several add-ins. Its central intelligence is designed around an implementation of the Tower of Hanoi algorithm (originally designed for backup and restore of mainframes and minicomputers).

The $1,695 Archivist NLM (NetWare Loadable Module) is the central product. Enhancement options include Capacity Expansion ($795), which doubles the amount of data protection; AutoLoader ($1,495), for automatic multiple-tape storage; Workstation ($695), for backing up client PCs; and File Manager, for simpler file backup and restoration through a queue server. File Manager is scheduled to be bundled with the NLM in the near future.

SUITABILITY TO TASK

Network Archivist

	POOR	FAIR	GOOD	EXCELLENT
Menu operation	●	●	●	●
Automation	●	●	●	●
Backup features	●	●	●	●
Restore features	●	●	●	●
Remote DOS backup	●	●	●	●
Mac file support	●	●	●	○

IT'S AUTOMATIC

One of Network Archivist's key features is its ability to automate an entire network backup, including scheduling, file migration, labeling, and tape rotation—all with little operator intervention. Network Archivist handles the tape changes and prompts the operator only to remove a tape from the rotation for off-site storage or to have one retrieved from off-site several days before it's needed again. It will also notify the operator when a tape is experiencing a large number of soft errors (when portions of the tape become unreliable) and should be replaced.

The workstation backup option is a TSR program, as with ARCserve and Mountain TapeWare. To assign a client PC for backup, the administrator simply uses the menus, and the script is automatically updated. Backup and restore operations using File Manager are just as easy.

Network Archivist offers a screenful of options for determining an archive and migration strategy.

Besides backup, Network Archivist supports file migration, an important feature for network administrators who don't wish to have a lot of disk space filled with old, unused data files. Using Novell's Last Access file attribute, Network Archivist migrates data meeting the set criteria off the server to tape. Once a file is migrated, a "phantom" file may be left in its place so a user will know that the file must be restored from tape to be accessed. Palindrome plans in Version 3.0 to support other large storage devices with much faster access times than tape—devices such as optical and magneto-optical disks. Version 3.0 should be available by the time you read this.

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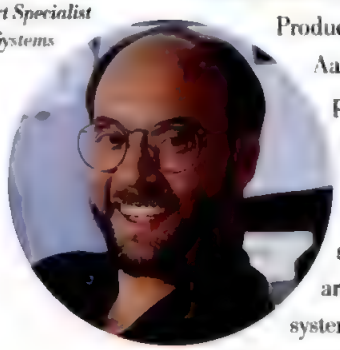

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433DX/D

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Diskette	3.5"	3.5"	3.5"	3.5"
Display	6312 14" SVGA NI	6312 14" SVGA NI	6312 14" SVGA NI	6314 14" SVGA NI
Operating System	IBM DOS & WINDOWS™	IBM DOS & WINDOWS	IBM DOS & WINDOWS	OS/2®
Price* / IBM Credit Lease**	**$1,579** / $57 per month	**$1,779** / $64 per month	**$2,029** / $73 per month	**$2,469** / $89 per month-

ValuePoint Desktop	425SX/D	433SX/D	433DX/D	466DX2/D
Processor	i486SX/25 MHz	i486SX/33 MHz	i486DX/33 MHz	i486DX2/66 MHz
Hard Drive/Memory	120MB/4MB	120MB /4MB	120MB/4MB	245MB/4MB
Diskette	3.5"	3.5"	3.5"	3.5"
Display	6312 14" SVGA NI	6312 14" SVGA NI	6312 14" SVGA NI	6312 14" SVGA NI
Operating System	IBM DOS & WINDOWS	IBM DOS & WINDOWS	IBM DOS & WINDOWS	IBM DOS & WINDOWS
Price* / IBM Credit Lease**	**$1,659** / $60 per month	**$1,859** / $67 per month	**$2,099** / $76 per month	**$2,779** / $100 per month

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Processor	i486DX/33 MHz	i486DX2/66 MHz	i486DX2/66 MHz	i486DX2/66 MHz
Hard Drive/Memory	340MB/4MB	527MB/4MB	527MB/4MB	527MB/8MB
Diskette	3.5"	3.5" & 5.25"	3.5"	3.5"
Display	6318 14" SVGA NI	6318 14" SVGA NI	6319 15" SVGA FS NI	6319 15" SVGA FS NI
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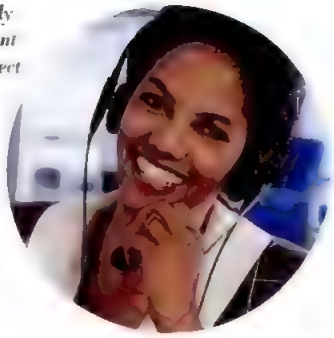

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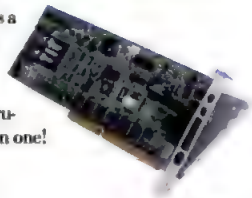

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Performance Tests: Multiserver Backup

How We Tested

Our test-bed was designed to simulate a group of networked file servers running NetWare, Version 3.11, with more than 650MB of data files. Our testing procedure focused on backup automation, so our filter required support for a tape autoloader. We chose the ADIC DAT Autochanger 1200C for testing because of its established credibility and widespread acceptance. With one exception, each of the packages here is designed to work as an NLM (NetWare Loadable Module) within a server; Xpress Librarian works on a dedicated client. Keeping in mind the expected operation of a tape backup system, we broke the tasks into two sections.

BACKING UP THE NETWORK

For the backup test, we created a directory structure with various trustee rights and user, application, and file subdirectories. Each was given unique attributes to simulate a typical network-rights environment. We tested backup of server files and attributes, automation methods, and file migration. We also tested for remote DOS hard disk backup.

We used three servers, each with its own design structure. The first contained 10 personal user directories with 250MB of files, and one directory consisting of 25 separate subdirectories—with the last directory holding five test files. This setup was used in order to test a package's ability to complete a standard backup and to determine if it would balk at a deep directory structure.

The second server had three directories with an assortment of ASCII documents. Groups were created with access to some directories but not others, and we added a set of users within each group. This setup was used to test a product's competence at properly backing up the NetWare Bindery. We left some files open during backup to see how a product handled open files. Some systems close such files, whereas others skip them and go back. Either way, the administrator should be notified in a status log.

The third server contained both data and ASCII documents in a large directory structure. We created groups and unique user rights for each directory and file to simulate a typical NetWare server. In addition, we connected a Macintosh to the test-bed and copied Mac file types to the server. We used the Mac files to test a package's ability to back up files with names longer than eight characters.

RESTORATION

To test each product's restore capabilities, we created a few tasks to search for specific files that were then tagged and restored onto the proper server. This single-file search test measured the speed at which a program can read the index and restore a file.

We then added to our tasks a random search and restore of specific files over a series of backup tapes. Because we used the ADIC Autochanger, we could test a product's index structure for search and retrieval of files created over a period of time. We timed the procedure to determine the best method. We also simulated a lost server and restored its entire directory and file structure, including its Bindery information.

After each task, we compared the restored files with the originals to check for corruption. We also tested the Bindery pattern to see if known users were still part of the Bindery and if the proper drive mapping and rights were restored.

What We Found

During our performance testing, we expected to see major differences between the packages because of the unique ways they approach backup. What we found instead were similar running times—on average, about 1 hour 15 minutes to complete the multiserver backup. (Xpress Librarian took an additional 40 minutes because it does meticulous indexing at the end of the backup. But for the extra time, it does offer a superior query technique.)

Mountain TapeWare and Xpress Librarian each requires its own 16-bit ISA SCSI controller instead of the 32-bit Adaptec 1740 EISA adapter supported by the other products, but we observed no loss of throughput when using the proprietary card. Xpress Librarian also has the disadvantage of depending on the network cable to back up all the servers; the other packages have direct support for the server to which the autoloader is attached. NetWorker turned in the best overall time for the procedure, thanks to its unique parallel backup method. The other products back up each machine sequentially and can work on only one server at a time.

Our biggest surprise came when we checked the network traffic on the cable. When we broke down the packets that transfer the data, we found that some products send the data in 1,500-byte packets, whereas others send only 512-byte packets. ARCserve and Network Archivist can send the packets in the larger size by taking advantage of NetWare's larger packet option built into the CLIB. Mountain TapeWare, NetWorker, and Xpress Librarian do not take advantage of this feature; NetWorker relies on Sequenced Packet Exchange (SPX) to guarantee packet delivery. (SPX does not take advantage of the large packet option.)

While testing support for restore functions, we found that ARCserve and Network Archivist retrieved files about 15 seconds faster than the pack. Network Archivist took full advantage of the CPU during this process—reaching 99 percent of utilization. ARCserve was able to save time by starting the search without any tapes mounted.

Each package required user intervention to search for and restore the files in our tests. Network Archivist uses a relational database, which should have made file queries easier than NetWorker's flat-file database (which required time working with the menus to search for and retrieve the files). We found, however, that the type of database employed neither enhances nor degrades performance.

▶ SUMMARY OF FEATURES

CONTINUES

Tape Backup Software

Products listed in alphabetical order

■ = YES □ = NO

	ARCserve	Mountain TapeWare	PC MAGAZINE EDITORS' CHOICE Network Archivist	NetWorker	PC MAGAZINE EDITORS' CHOICE Xpress Librarian
Price (tested configuration)	$13,295	$11,193	$13,485	$15,505	$14,980
Hardware Support					
Tape-server architectures supported under:					
Microsoft LAN Manager 2.0 and 2.1	None	None	None	NLM, Unix	None
OS/2 LAN Server	None	None	None	NLM	None
NetWare 2.*x*	None	None	DOS	Unix	DOS, Windows
NetWare 3.*x*	NLM	DOS, NLM	DOS	NLM, Unix	DOS, Windows
NetWare 4.0	NLM	None	DOS	NLM, Unix	DOS, Windows
PathWorks	None	None	None	None	None
VINES 4.11, 5.0, and 5.5	None	None	None	None	None
File and application server support under:					
Microsoft LAN Manager 2.0 and 2.1	Partial	Full	None	Full	None
OS/2 LAN Server	Partial	Full	None	Full	None
NetWare 2.*x*	Full	Full	Full	None	Full
NetWare 3.*x*	Full	Full	Full	Full	Full
NetWare 4.0	Partial	None	Partial	Full	Partial
PathWorks	None	None	None	None	None
Unix	Full	Full	None	Full	None
VINES 4.11, 5.0, 5.5	None	None	None	None	None
Backup Features					
Adapts to hardware changes	□	□	■	■	□
Archiving supported	■	■	■	■	■
Attended and unattended backups	■	■	■	■	■
Backups running in background	■	■	■	■	■
Continues operating after error	■	■	■	■	■
Finds and displays file versions	■	■	■	■	■
Includes/excludes files for backup based on:					
Directory	■■	■■	■■	■■	■■
File extension	■■	■■	■■	■■	■■
Group	□□	□□	□□	□□	□□
Hidden files	■■	■■	■■	□□	□□
Individual file	■■	■■	■■	■■	■■
Network user	□□	□□	□□	□□	■■
Open files	□□	□■	■■	□□	□■
System files	■■	■■	■■	□□	■■
Volume	■□	■■	■■	■■	■■
Incremental backup	■	■	■	■	■
Keystroke learning	□	□	□	■	■
Macro language to program tasks	□	■	□	■	■
Multiple file sets per medium	■	■	■	■	■
Multiple media per file set	■	■	■	■	■
Multiple server backup	■	■	□	■	■
NetWare SMS-compliant	Optional ($100)	□	□	■	□
Reads the Bindery for user rights	■	□	■	□	■
Remote operation	■	■	■	■	□
Retains NOS-specific attributes	Some	All	All	All	All

SUMMARY OF FEATURES

ENDS

Products listed in alphabetical order

■ = YES □ = NO

	ARCserve	Mountain TapeWare	PC MAGAZINE Network Archivist	NetWorker	PC MAGAZINE Xpress Librarian
Backup Features (continued)					
Retries open files	■	■	■	□	■
Schedules backup by:					
Regular/specific interval	■■	■■	■■	■■	■■
Specific time and date	■	■	■	■	■
Single-console control	■	■	■	■	□
Backup verification optional (not required)	■	■	■	■	■
Media verification optional (not required)	■	N/A	■	■	■
Compression Support					
Software or hardware	Hardware	Hardware	Hardware	Both	Hardware
Compression can be turned on or off	■	□	■ (depending on hardware)	■	□
File Migration					
Resets archival bit	■	■	■	■	■
Archiving included	□	□	■	■	■
Generates file-aging reports	■	□	■	■	■
Generates file-use reports	□	□	■	□	■
Performs disk grooming	■	□	■	□	■
File-aging parameters supported	Last access date	None	Last access time, modification date, time and date range	Last access time	Last access date, modification date
Device Support					
4-mm and 8-mm DAT	■	■	■	■	■
Optical devices:					
Autoloaders	■	□	■	□	□
QIC SCSI drives	■	■	■	■	■
Rewritable drives	■	□	■	□	□
WORM drives	■	□	□	□	□
Media Management					
Backup can span multiple tapes	■	■	■	■	■
Includes tape-rotation scheme	■	■	■	□	■
Logs tape errors	■	■	■	□	■
Logs tape usage	■	□	□	□	■
Serializes tapes; prompts by number	■	■	■	■	■
Security					
Active client secured	■	■	■	■	■
Data encryption	□	□	□	■	■
Password protection	■	■	■	■	■
Requires log-on to execute	■ (remote server only)	■	■	■	□
Technical Support					
BBS support	■	■	■	■	■
Fax-back support	■	■	■	■	■
Free telephone technical support	■	■	■	■	■
Duration of technical support	Unlimited	Unlimited	Unlimited	6 months	Unlimited

N/A–Not applicable The product does not perform media verification

PC MAGAZINE EDITORS' CHOICE

FACT FILE

Network Archivist, Version 2.0

Palindrome Corp., 600 E. Diehl Rd., Naperville, IL 60563; 708-505-3300; fax, 708-505-7917

List price: Main program, $1,695. Palindrome Autoloader Software, $795, FAST 2000 AutoLoader, $10,995, FAST 2000C AutoLoader, $11,995

Requirements: Server: 2MB RAM, 2MB hard disk space, NetWare 2.x or later. Client: 286-or-better processor, 512K RAM, 2MB hard-disk space, DOS 2.x or later

In short: Excellent automation, data-protection, and migration capabilities—combined with an intuitive interface—make Network Archivist a good choice. An automatic scripting program and support for both DOS and Macintosh files sweeten the deal

443 ON READER SERVICE CARD

arrow keys or a mouse to navigate through directories and files. When a file is selected, a detailed backup history is displayed listing the dates and tapes on which the file is stored. Files existing on the current volume and files that have been migrated from the volume are displayed in different colors. This lets the operator know which files exist on the network and which exist on tape.

Backed-up data is protected in two ways: saves and checkpoints. Saves are unchanging files such as .COM, .EXE, help, and older data files. When a file is considered stable, Network Archivist makes from two to eight copies (the default is three) on separate tapes. Once these criteria have been met, Network Archivist considers the file fully protected and will no longer back it up unless it is changed.

Checkpoints are files, usually data files, that are constantly being updated. These files are kept on every tape in a rotation scheme, so multiple copies of a file—possibly dating back weeks—can be searched for and restored. The more tapes being rotated into the cycle, the longer the data-recovery period.

Network Archivist performed slightly slower than its competitors on our performance tests because of the way it searches its database for the save and checkpoint criteria before it starts a backup. Where Network Archivist excels is in its ability to intelligently determine the stability and activity of files on a server and then back up only those that are active. As a result, less data eventually needs to be backed up, making the process faster over time.

Network Archivist provides better-than-adequate documentation. It incorporates easy-to-follow instructions and offers some scenarios of network backup configurations. Palindrome offers a 30-day money-back guarantee on the software, a one-year warranty on the hardware, and unlimited technical support (via a toll number). Extended support is available after hours and on holidays.

Network Archivist's ability to automate most of the day-to-day hassles of backing up a network leaves you more time to complete other important tasks. It also makes the package a very powerful tool for network administrators. Its minor installation problems and initially slow speed are offset by its data protection and ease of use, which make it a backup solution for networks of all sizes.

Legato Systems Inc.

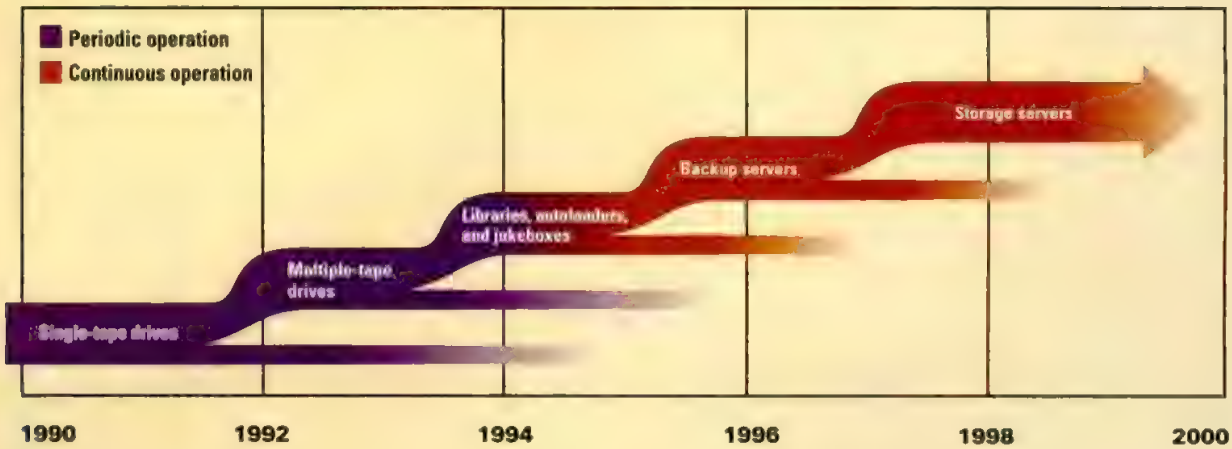
NetWorker

BY CHARLES P. KOONTZ

If NetWare shipped with enhanced tape backup, it might have been Legato Systems' NetWorker, Version 2.11, also sold by Conner Peripherals as Conner NetWorker. Thanks to system patches and its use of NetWare's SMS (Storage Management Services), NetWorker (a version of which is also sold by Conner Peripherals as Conner NetWorker) not only ensures proper handling of NetWare's attributes and security information, but it is also the best guarantee for future NetWare compatibility. Unfortunately, its limited migration and archiving facilities don't take full advantage of an autoloader's potential.

NetWorker's server software runs on a NetWare file server with an attached tape drive (the autoloader here), and its client software runs on every PC to be backed up—clients and file servers as well as the machine running the server software. Cli-

The Evolution of LAN Backup Hardware



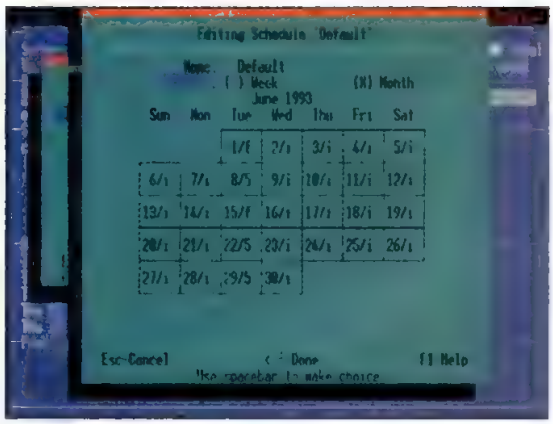
Backup hardware will eventually progress beyond today's multiple-tape drives and autoloaders. Dedicated backup servers will further automate the continuous backup and migration of files, unburdening LAN managers and making it even easier for users to retrieve data.

ents may be running DOS, O2/2, or Unix.

The software is installed as an NLM (NetWare Loadable Module) at the server console, and the menu-driven installer offers options for setting up all of NetWorker or just the client software. (The NetWorker server needs both because it must also be considered a client to back up its own files.) Both server and client routines run from the same menu and the same set of disks. The included patches have to be copied to the system directory and marked as read-only, a somewhat tedious process.

Where most systems rely on backup scripts for automation, automatic backup in the NetWorker world is structured around groups, schedules, and policies. A group is a collection of clients, not a NetWare group. A schedule is a calendar of different types of backup procedures for groups. A policy is a retention interval for files saved on tapes.

In addition to offering full and incremental backups, NetWorker provides nine levels between the two; each successive level backs up files that have changed since the last backup of a lower level. For example, level five backs up any files changed since the last level-four backup. All this makes configuring the backup strategy a bit complex, though it is designed to make file recovery easier.



NetWorker's calendar interface lets administrators arrange a backup strategy visually.

WRITTEN FOR SPEED

NetWorker's ability to back up multiple data sources simultaneously makes the system scream, writing the data as fast as the tape drive can handle it. And in its most interesting performance aspect, NetWorker can back up multiple clients simultaneously by multiplexing data onto the tape drive.

Restoring files is fast as well, although NetWorker's menu requires you to identify the client (workstation or server) where the data was located. NetWorker's range of backup and restore features is good, though, and even includes a menu selection for "recover from a disaster." And its use of an actual calendar (not just a date field) for scheduling is useful.

During backup and restore procedures, NetWorker's library software tracks tape contents and controls the autoloader's tape mounting, but that's as far as it goes. Data migration to archive volumes is adequate but not spectacular. The default is automatic archival of files not accessed in the previous 90 days.

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FACT FILE

NetWorker, Version 2.11
Legato Systems Inc., 260 Sheridan #415, Palo Alto, CA 94306; 415-329-7880; fax, 415-329-8898

List price: 1 file server and 10 workstations, $750; 2 file servers and 20 workstations, $1,400; 6 file servers and 100 workstations, $2,500; 16 file servers and 250 workstations, $4,000; 26 file servers and 500 workstations, $7,500.

Requirements: Server: Adaptec or Bus Logic ISA, EISA, or MCA SCSI adapter (or Tricord Server); 4MB RAM (6MB to 8MB recommended), 5MB hard disk space plus 2 percent to 5 percent of total network space for indexes, NetWare 3.11 or later. Client (optional): 640K RAM, 700K hard disk space, DOS 3.3 or later.

In short: Despite SMS support and the best NetWare integration of all the packages we tested, NetWorker falls short when it comes to file migration, archiving, and restoring. Its limited hardware requirements on the client end, however, may make it worth a look for administrators with only basic backup needs.

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NetWorker can skip seldom-needed files (.BAK, .TMP, etc.) during backup or archive them to tape and then delete them from the system. That's the extent of NetWorker's disk grooming.

The system's weakest point is its menu-driven interface, which severely limits search capabilities by allowing only simple wildcard queries. A quirky Escape-key function is no help.

NetWorker's restoration may leave you wanting. Finding files for a restore operation offers only two choices: Find a filename and find it again. If you use wildcards in the search, you don't see a list of matching files; you have to find the first match and then find the next, repeating the process until you find the file you really want. On the plus side, if the tape that contains the file is in the autoloader, NetWorker will mount it automatically and retrieve the file.

The only performance problem we encountered had to do with NetWorker's recommended SCSI bus synchronous transfer speed of no greater than 5MB per second. The default setting in the Adaptec 174*x* controller's EISA configuration file is 10MB per second. According to Legato, you need to verify the SCSI synchronous transfer rate because the higher speed can cause retries and slow the system. The system performed well, however, despite the incorrect setting.

If you're seeking a well-integrated backup solution, and your needs for file migration and archiving are only basic, NetWorker's SMS support and connections to NetWare make it worth a look. But its frustrating restore functions may mean that the look should be a long one.

SUITABILITY TO TASK

NetWorker

	POOR	FAIR	GOOD	EXCELLENT
Menu operation	●	●	●	○
Automation	●	●	●	●
Backup features	●	●	●	●
Restore features	●	●	●	○
Remote DOS backup	●	●	●	○
Mac file support	●	●	●	●

MOVING?

Please write to: PC Magazine, P.O. Box 54093, Boulder, CO 80322. Include your mailing label from a recent issue of PC Magazine for faster service. Please allow up to 60 days for change of address to take place.

Emerald Systems Corp.

Xpress Librarian

BY CHARLES P. KOONTZ

Unique among the products we tested, Emerald Systems Corp.'s Xpress Librarian, Version 2.0, is a client-based backup system running under Windows on a NetWare network. The other packages we saw are server-based with menu interfaces. Although not a distributed client/server application, Xpress Librarian can handle volumes on multiple file servers. It offers backup, archive, and restore functions; a librarian to manage tapes and long-term archiving requirements; and an event scheduler. Xpress Librarian functions automatically with NetWare volumes and has an option to back up local drives on a peer-to-peer network. It also offers some interesting bells and whistles, including a periodic virus scan ($995) and the ability to call a pager to report errors ($395).

SUITABILITY TO TASK

Xpress Librarian

	POOR	FAIR	GOOD	EXCELLENT
Menu operation	●	●	●	●
Automation	●	●	●	●
Backup features	●	●	●	●
Restore features	●	●	●	●
Remote DOS backup	●	●	●	●
Mac file support	●	●	●	●

As a client-based system, one of Xpress Librarian's drawbacks is the additional—proprietary—hardware that it requires: You must install Emerald's SCSI host adapter on a client PC and cable it to the tape changer. After that, however, installation is straightforward.

You can choose automatic or manual installation, depending on whether you need to specify the directory for Xpress Librarian's files. Once the software is installed, you must specify several hardware settings and then use the utilities to test the installation. The autoloader option is added using a normal Windows installation routine.

The default automatic installation produces a group of three icons: backup engine, librarian, and scheduler. Options such as virus scanning show up in this same group. The backup engine performs backup, restore, and tape-control operations on a short-term basis. You select files using normal Windows selection procedures. Tape functions include manual tape-changer control from the keyboard, which requires the user to oversee the entire procedure.

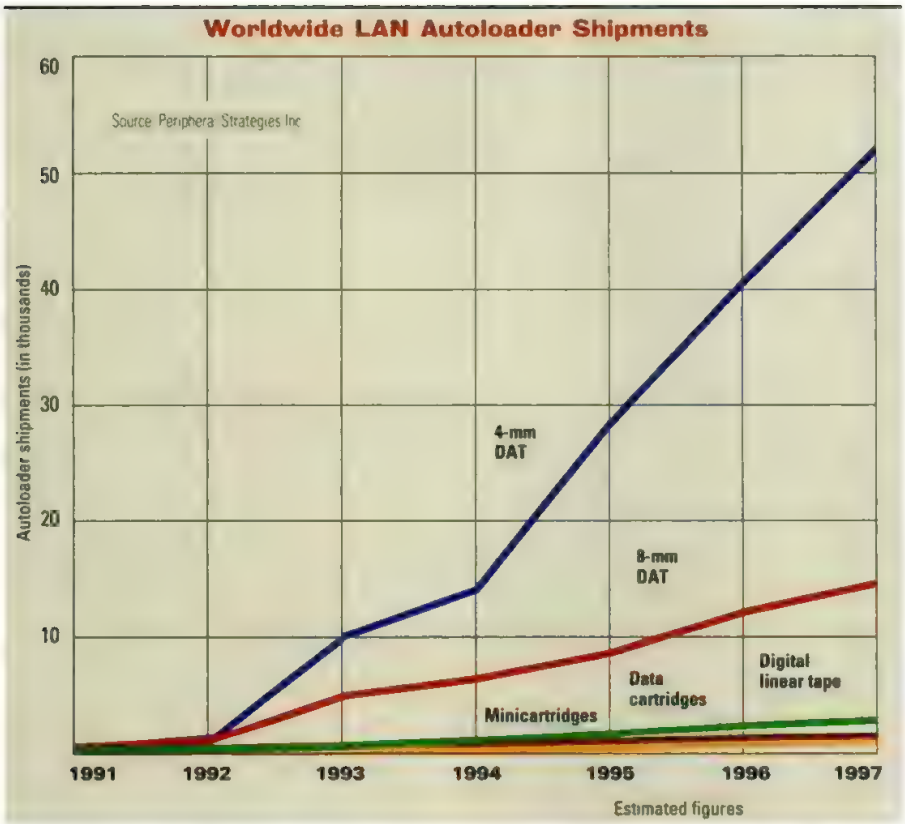
To remove as much of the human factor as possible, the package relies on the librarian and scheduler. The librarian manages data archiving, disk grooming, and file tracking. Its file-aging report offers several parameters for automatic deletions and archiving, including four ranges of file ages, files to include, files to exclude, file size, and ownership. This means you can, say, specify automatic deletion of .BAK files older than 60 days and over 200K while excluding a single important .BAK file. The librarian also offers a nifty file-usage report that tells

How Safe Is Your Data?

Protection of network data often falls to inexperienced network administrators. The various aspects of this job make up a difficult set of complex tasks that sometimes conflict with perceived responsibilities.

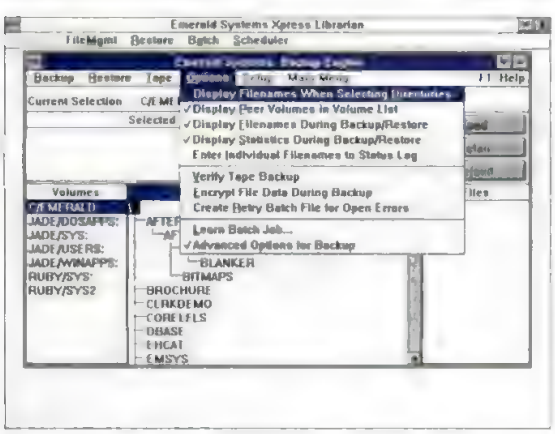
Are your backup procedures an afterthought, or an integral part of your network management? To help assess how well protected your LAN is against threats to its data, ask yourself the following question:

	Yes	No
1. Is your backup always done on schedule, or is it sometimes missed or incomplete?	☐	☐
2. Are backups always fully verified? Are the backup tapes periodically tested to prove that the data can be restored?	☐	☐
3. Are all servers and clients included in your backup/restore policies?	☐	☐
4. Do you have centralized control with uniform backup policies and procedures?	☐	☐
5. Do you spend too much time managing the backup process, including media labeling, tracking, and rotation?	☐	☐
6. Is the time allotted for backup sufficient for your backup program to be completed?	☐	☐
7. Are file restores easy to do?	☐	☐
8. Are you managing file clutter and keeping your disk-expansion costs in line?	☐	☐
9. Do users spend too much time backing up and managing their own file space?	☐	☐
10. Do you use automated file migration?	☐	☐
11. Can users easily retrieve their own files?	☐	☐
12. Can you easily trace your files and records in both local and off-site archives?	☐	☐
13. Can you easily add new servers or clients to the backup process?	☐	☐
14. Is there a fully implemented disaster protection plan? Has it been tested?	☐	☐



Worldwide sales of 4- and 8-mm DAT autoloaders are expected to increase sharply in the coming years, while other media will experience much slower growth.

how much space each NetWare user owns; it's a help in encouraging voluntary disk-space limits. For periodic backup and archiving events, the scheduler can run batch programs to perform backup, archival, and other operations on periodic schedules. It also can automatically archive and delete files based on type and execute any batch file on schedule. You can, moreover, teach it an operation to be stored as a batch file.



Xpress Librarian's Windows interface lets administrators set up features by clicking on the appropriate item or menu.

Xpress Librarian's backup and restore operations—which work just as well for clients, binderies, and Mac files—are the best we saw, despite being slowed by the 16-bit SCSI interface. File searches can be based on the volume, directory, and filename, or on just the filename. Wildcards are legal as well. If you search by file, Xpress Librarian searches its database and lists all occurrences of that file and the tapes that contain it. If you know the tape volume and directory, the search is faster. In any case, if the correct tape is already in the autoloader, it will mount it and retrieve the selected file.

That is only one aspect of Xpress Librarian's excellent autoloader support, which may be the best of the bunch. Once the system is properly installed and configured, you can load a full magazine of tapes into the autoloader and practically forget about it. Xpress Librarian even makes provisions for keeping a cleaning tape in the autoloader. Moreover, the software can distinguish between backup and archive tapes even in the same tape magazine.

NOBODY'S PERFECT

Because Xpress Librarian runs under Windows, it is subject to Windows' problems. We saw occasional General Protection Faults while attempting to back up a client PC's local hard disk but were able to solve the problem quickly. And the system locked up occasionally during a restore operation, but when we cycled the power on the autoloader, the operation continued.

Xpress Librarian's help functions are also weak. Help isn't context-sensitive, nor is it available all the time and for all the features on-screen. It also seems like it was written by engineers for engineers instead of for system administrators.

But for network backup beyond the simple put-it-on-tape philosophy, Xpress Librarian's archival, grooming, and migration features—and its exceptional use of the autoloader—make it an excellent choice for state-of-the-art LAN file management and a viable part of an overall data-storage plan. □

PC MAGAZINE EDITORS' CHOICE

FACT FILE

Xpress Librarian, Version 2.0

Emerald Systems Corp., 12230 World Trade Dr., San Diego, CA 92128; 800-767-2587, 619-673-2161; fax, 619-673-2288

List price: Main program, $995. Autoloader module, $495, peer-to-peer module, $495, pager option, $395; anti-virus option, $995, autoloader with noncompression drive, $11,995, autoloader with compression drive, $12,995

Requirements: 286-or-better processor, 2MB RAM (4MB recommended), 1.5MB hard disk space plus 1MB per gigabyte of data backed up, DOS 3.3 or later, Microsoft Windows 3.x, 16-bit Emerald SCSI controller and cable, Emerald tape drive or ADIC Autochanger.

In short: The only client-based system we reviewed, Xpress Librarian runs under Windows and handles DOS and Macintosh files. It offers an intuitive interface; top-of-the-line backup, migration, archive, and restore capabilities; and excellent autoloader support. Options include periodic virus scanning and pager notification via separate modules. Its only drawback is the proprietary SCSI card it requires.

445 ON READER SERVICE CARD

PC MAGAZINE

Network Edition

THE LATEST NETWORK PRODUCTS AND MANAGEMENT TECHNIQUES

To Catch a Thief

Security is key to the next generation of operating systems. But is there more to security than simply a secured operating system?

By Frank J. Derfler Jr., Max Schireson, and Tim Stefanini

Effective network computing demands more than gigabits of bandwidth, sleek client/server applications, and glitzy network management. To be the backbone of the corporate information infrastructure, network computing must incorporate effective security measures that protect vital information.

Today, most network operating systems implement some form of security, even if it is a simple password. But passwords are only a first line of defense. Since the disclosure of certain information often presents a bigger liability to your company than the theft of actual products, you must guard your networks with more than a simple lock and key.

A new flurry of development both in the commercial and in the standards arenas has made networks more secure. These changes form part of a cohesive industry strategy that includes full use of security features in today's operating systems, effective administrative practices, and proper password maintenance.

Perhaps the most significant security announcements have come from industry leaders Microsoft and Novell. Both companies are either building or plan on building C2-level security into the kernel of Windows NT and NetWare 4.0, respectively. But C2-level security, a government specification for secure operating systems, is just one component of a secure network. Several standards bodies are developing standards that will specify a more secure physical network. Hub vendors such as 3Com Corp., SynOptics Communications, and Ungermann-Bass now offer a variety of security features in their products. And now enhancements to the Simple Network Management Protocol (SNMP), the predominant protocol for managing network devices, will make management more secure.

These developments are in addition to

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POINT

CLICK

ARCserve [Job Monitor]

File Manager Window Help

Job Type BACKUP Operation BACKUP Node # 2 of 5

Host Server ENTERPRISE Owner SUPERVISOR

Source: ENTERPRISE << NetWare 3.11 >>

Destination: SONYTAPE Session 12 Seq 1 ID BDCC

Progress

Source Path VOL1:\BITMAPS

DOS File LIGHT256.BMP Size 308,278

Avg. Throughput 20,160 KB / Minute

Session Counts

Total # Files Processed 5 Est. Files 98

Total # K Bytes Processed 1,277 Est. KBytes 8,140

Total # K Bytes To/From Tape 1,344 Est. Time Left 21

Elapsed Time

Hr 24 Min 31 Sec

ARCserve

File Manager Window Help

Report

ENTERPRISE

The "Activity Log" details the operations performed by ARCserve. This log lists the activity performed, the date and time it occurred, and the name of the user who submitted the job. It also shows whether the job was completed or if an error occurred.

ENTERPRISE::Activity Log

- Activity Log
- Tape Server Log
- Auto Pilot Daily Log
- Auto Pilot Full Log
- Auto Pilot Grooming Log
- Job Queue Log
- Auto Pilot Profile Report
- Job Report
- Tape Media Report
- Tape Session Report

```
May-18 21 29:08 ASDB  Daemon buffer size purgeFTS=16 backupFTS=500 arch
May-18 21 29:08 ASDB  ARCserve database initialized
May-18 21 29:09       Queue:  AQ_CHEY
May-18 21 29:09       Console process initialized
May-18 21:29:10       Real-time broadcast system initialized
May-18 21:29:10       ARCserve scheduler is ready
May-18 21 29:12 CLIENT Ready to monitor IPX and AFP workstations
May-18 21 29:51       Queue:  AQ_CHEY
May-19 09 22:59 ASDB  Daemon buffer size: purgeFTS=16 backupFTS=500 arch
May-19 09:22:59 ASDB  ARCserve database initialized
May-19 09:23:01       Queue:  AQ_CHEY
```

ENTERPRISE 05/27/93 03:42:58PM

ENTERPRISE BACKUP

yes It runs with NetWare

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the technologies used in today's networking products such as Public Key Cryptography and Kerberos and the security facilities already built into popular network operating systems.

Overall, this convergence of security products, standards, and technologies spells good news for network managers. Now you can port security features normally found on the mainframe down to the LAN. With these new options, it's more important than ever that you master the intricacies of network security to better plan for its use in your network.

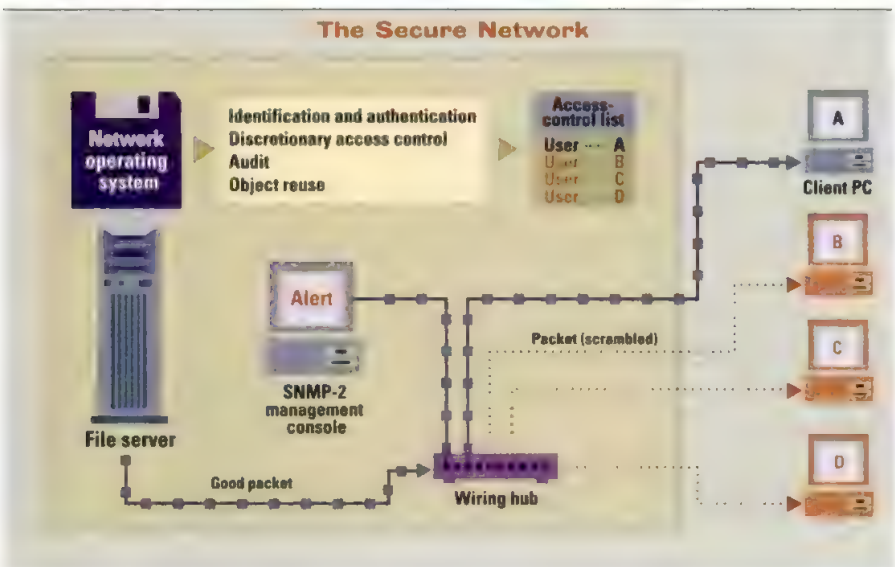
NOS SECURITY

The most important decision in determining the security level of your network is your choice of operating system. While many add-on products can increase the security of an existing system (restricting access to a PC, for example), if the underlying operating system isn't secure, neither is your network.

While most network operating systems have some degree of security built-in, new operating systems such as NetWare 4.0 and Windows NT were designed from the ground up with security in mind. They contain features that form a trusted computing base (TCB) within the operating system, which starts with encryption.

In a TCB environment, passwords are encrypted when they go across the network. Windows NT uses Data Encryption Standard (DES) encryption and NetWare 4.0 uses the RSA algorithm (named after its inventors: Rivest, Shamir, and Adleman), but both systems contain safeguards against bypassing the log-on system by rebooting or using other tricks. The operating systems can restrict specific log-ons to specific machines and only allow the user to log on at certain times.

Both NetWare 4.0 and Windows NT will provide certain user groups—e.g., administrator, backup operator, print operator, and domain administrator—with the appropriate privileges to perform that group's functions. This structure makes it possible to give each user exactly the access they need: When the user tries to access a system resource, the operating system—using a TCB function called discretionary access control—checks an access control list.



A secure network involves all aspects of computing, from the management console to the network operating system.

One of the biggest limitations of a network security system is an inability to notify someone when an attempted security violation occurs. Under NetWare 3.11, violations are simply written to a log file and optionally written to the console screen. NetWare 4.0 and Windows NT not only provide the ability to log all kinds of security violations, they can also trigger an alarm on the server screen or forward the warning to any other system on the network.

Remote access via modems is a back door that is easily exploited. Both NetWare 4.0 and Windows NT provide a secure environment for remote access to the server. Under NT, each account must be specifically granted the right to access the server remotely, and remote administration of the server requires an additional privilege. Under both systems, passwords are encrypted during remote access just like they are during local log-ons.

One of the less-heralded security features of NT will be its ability to enforce the parameters of each end user's environment through its directory replication and user profile services. Directory replication provides an automated way to update the software environment for all end users. The user profile editor allows an administrator to control which resources an end user can access.

NetWare 4.0 will eventually include a new security feature called the NetWare Core Protocol (NCP) packet signature that prevents users from replaying previously captured packets to initiate network actions. When NCP packet signature is implemented, processes running in the server and client sign each NCP packet while slightly changing the correct packet signature with every packet. NCP packets with an improper signature are discarded and the action is logged. However, packets with NCP signatures will not be compatible with NetWare, Version 3.11.

Both NetWare 4.0 and Windows NT will allow you to use domains to break up your network logically: You can effectively encapsulate each network group within its own layer of security. This means that a security breach in one domain won't spread throughout the entire network. Both will also allow programs running on the server, such as a database engine, to use the operating system's internal security structure so that the application has a trusted path to its data.

While Novell uses the concept of domains for security access, a NetWare utility called DOMAIN.NLM has a completely different function that relates to another part of the TCB called object reuse. This is a function in the operating system that cleanses each object space such as RAM and disk space prior to its assignment to another user. Both

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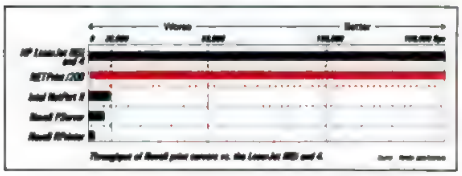

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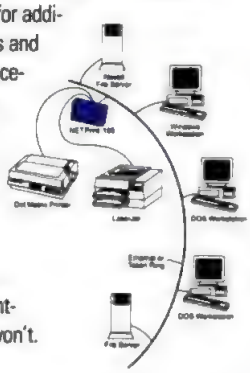

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NETPrint 200	Ethernet 10Base-T and BNC Thinnet 4/16MB Token Ring DB9 and RJ45	Single Novell	3-parallel 1-RJ45 Unport	512K ROM 512K RAM	$795 (E) $1395 (T)
NETPrint 200P	Ethernet 10Base-T and BNC Thinnet 4/16MB Token Ring DB9 and RJ45	Multiple Novell Apple	3-parallel 1-RJ45 Unport	512K Flash ROM 2M RAM	$995 (E) $1495 (T)
JETXPrint 100	Ethernet 10Base-T and BNC Thinnet 4/16MB Token Ring DB9 and RJ45	Single Novell	1-MIO interface	512K ROM 512K RAM	$445 (E) $695 (T)
NETPrint 100	Ethernet 10Base-T and BNC Thinnet 4/16MB Token Ring DB9 and RJ45	Single Banyan	1-parallel 1-RJ45 Unport	512K ROM 512K RAM	$695 (E) $1195 (T)

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NetWare 4.0 and Windows NT check the previously used spaces and then limit the program's activity to only the assigned spaces. DOMAIN.NLM guards memory from corruption or use by other active NetWare Loadable Modules (NLMs).

REALLY SERIOUS SECURITY

If you have research material, government secrets, or other very private data to protect, you'll take extraordinary steps to establish a secure network. Since the U.S. government has been worried about network security since the early 1960s, becoming familiar with its guidelines is useful. The National Computer Security Center (NCSC), a department of the National Security Agency (NSA), is the main government agency responsible for computer security guidelines.

The NCSC evaluates security products according to guidelines published in the Department of Defense Trusted Computer System Evaluation Criteria, informally referred to as "the Orange Book" after its cover. Windows NT and NetWare 4.0 are currently under evaluation for C2-level security certification by this agency. The differences between the products will come in how intrusive the security is to end users, how difficult the features are to administer, and how much they slow system performance.

The National Institute for Standards and Technology (NIST) also plays an important role in developing security training programs and standards such as DES. DES encryption is currently used in many network products (a complete list is published in the NSA's Endorsed Data Encryption Standard Products List). DES uses a 64-bit key that is only known by the sender and receiver.

Even more stringent encryption is provided by the RSA algorithm, which uses both a private and a public key, each 512 bits long. The public and private numbers are mathematically related so that data is encrypted using the private key and decrypted using the public key. This makes it possible to verify exactly who sent the encrypted information. RSA is considered nearly impervious to brute force attack. It is based on factoring extremely large numbers, which requires enormous amounts of computation using current algorithms.

Kerberos, a Unix-only solution right now (it is not available for NetWare or Windows NT) is an authentication system that relies on DES encryption to transmit authorization information securely. When a user logs on, an authentication server issues a time-stamped ticket to the user. That ticket, after being decrypted using the user's password, enables the user to access network services. The ticket expires in 8 hours, so if someone captures the decrypted ticket, they cannot use it to impersonate the user indefinitely. Since the user never transmits a password

Tips for Securing NetWare 3.11

Novell's NetWare 3.11, like most network operating systems, comes with a wealth of security features that are not enabled. To secure your system, start by following Novell's guidelines. These guidelines and others are published in NetWare Security: Configuring and Auditing a Trusted Environment, published by Novell Research and written in cooperation with Coopers and Lybrand.

According to Novell, following the recommendations will yield Orange Book C-level security, comparable to the C1 or C2 class. The security level provided by the recommendations has not been officially certified, and NetWare 4.0 is Novell's chosen product for high security, but it is generally accepted that a well-administered NetWare network or Unix system with no special security features would probably receive a C1 rating. The guidelines primarily protect a system from break-in attempts based on repeated trials of password cracking. The following are Novell's guidelines:

Recommended default account balance/restrictions: (use default)
- Account has expiration date: no
- Date account expires: (use default)
- Limit concurrent connections: yes
- Maximum connections: 1
- Require password: yes
- Minimum password length: 5
- Force periodic password changes: yes
- Limit grace logins: yes
- Grace logins allowed: 1
- Require unique passwords: yes
- Account balance: 0
- Allow unlimited credit: yes
- Low balance limit: (use default)
- Intruder detection/Lockout settings: (use default)
- Detect intruders: yes
- Intruder detection threshold: (use default)
- Incorrect login attempts: 3
- Bad login count retention time: 1 day 0 hours 0 minutes
- Lock account after detection: yes
- Length of account lockout: 7 days 0 hours 0 minutes

Although Novell recommends a minimum password length of five characters, you might consider requiring passwords of at least eight characters for increased security. These guidelines balance intrusiveness with security; requiring more frequent password changes increases security, but at the price of a greater administrative burden.

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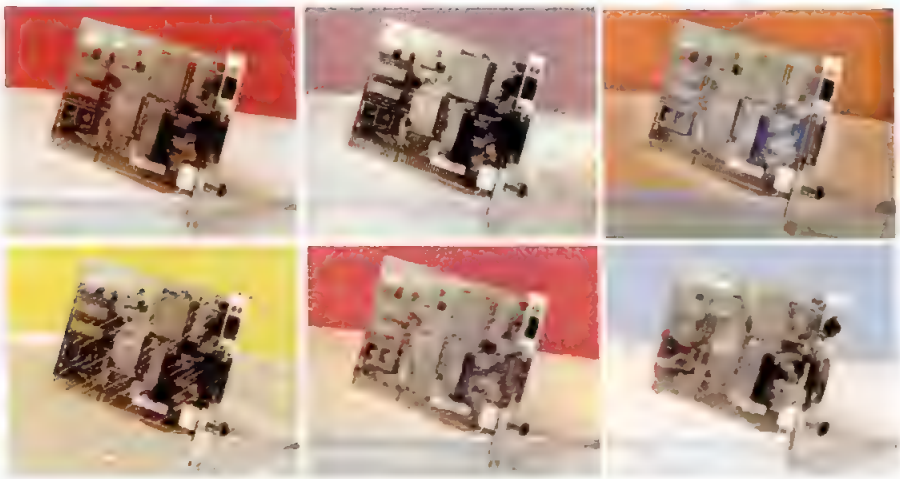

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across the network, it cannot be compromised. In situations where eavesdropping is a concern, all information transmitted between a workstation and a service can be encrypted.

Another benefit of Kerberos is that it provides mutual authentication, in which you—the user—identify yourself to services, then they identify themselves to you. Services authenticate themselves to users so that users know they are actually storing confidential information in the corporate database, not sending it off to some clever hacker.

But Kerberos is limited because it depends on the physical security of the networked devices. Having more than one user logged on to the same workstation at the same time compromises network security.

Sun offers Kerberos as an option to Secure RPC and Secure NFS—its C2-securable networking features available in Solaris, Version 2.1. Last, each network service must be individually modified to work with Kerberos. This means that getting Kerberos to run in your environment could take days with a highly paid Unix expert.

SECURITY SCORECARD: D TO A1

The Orange Book defines seven different security levels: D (least secure), C1, C2, B1, B2, B3, and A1 (most secure). Each security rating has requirements in terms of security policies (discretionary vs. mandatory access control, labeling confidential documents, etc.), accountability (such as identification of a user and the ability to audit the users' actions), assurance (requirements that verify a system's security has been implemented correctly), and documentation requirements (how to use the systems security features, documentation of tests of the system, and documentation of system design). As you approach A1 security, these requirements increase and become more intrusive.

An operating system that lets anyone use it and have complete access, such as MS-DOS, falls into the D security class. C1 security starts by requiring users to identify themselves and limits their access accordingly. C2 systems require the system to ensure that once objects are used, they are cleared out so that they can't be accessed again. This means that once you log off of a system, no one has access to your memory pages or buffers. It also requires the system to provide the ability to audit user activities. C2 is the highest security level that is not considered intrusive—it does not change the way in which an end user is forced to work with the system.

Under B1 security, the work environment changes dramatically. Access controls for every object in the system become mandatory. This level of security also requires that all classified information be labeled, both for files and printouts. Because of this, B1 security is often not practical for commercial sites; it creates a great deal of overhead and is cumbersome to use. At the B2 level, every device on the network is also assigned a security label, and each user is notified at what security class they are

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operating. At this level, the system also has to guarantee that all applications through which trusted information is communicated are also trusted. Those applications that are part of a TCB, that follow these guidelines, and that allow hardware access only through the operating system are considered trusted applications. These security classes also require data to be secure even in the event of a system crash.

These standards provide a means of fair and consistent discussion and comparison of security features. Keep in mind, though, that they are macro groupings—you will probably not need anything but D, C1, C2, and B1 products in the next 10 years. Mostly, you will choose between C1 and C2.

EVOLVING STANDARDS

Outside the world of operating systems, a number of standards that will further enhance network security are being developed. The Internet Engineering Task Force (IETF) and the IEEE are currently working on standards for more secure networks. One new development is the IEEE 802.10 Secure Data Exchange Standard. This standard describes a way to encrypt the data portion of a packet but not its address header, so the packet can still be routed. It is being incorporated into the 802.11 wireless networking standard to provide a secure channel for wireless networking.

Another specification, the new Simple Network Management Protocol 2 (SNMP-2), due later this year from the IETF, provides several security enhancements to the original SNMP. The most significant of these enhancements is the use of DES encryption on network packets. DES encryption, along with the time stamp that SNMP-2 places on all network packets, secures the network from physical attack by someone trying to replay or simulate legitimate network management commands. Under the new SNMP-2 protocols, packets are valid only for a short period of time.

3Com was one of the first companies to offer secure SNMP and will release a SNMP-2 version as soon as it is ratified. The company has a patented technology called the LAN Security Architecture (LSA) that uses secure repeater chips in the wiring hubs to reduce the threat of eavesdropping on the network cable. With LSA working over 10BaseT networks, only properly addressed network nodes can read the data within a packet. This feature is available in some 3Com wiring hubs and can be licensed to other vendors at a low cost.

COMPOUND SECURITY

Despite the sophisticated ciphers and monitoring programs, the most common network security problems stem from poor administrative practices. Kerberos servers and C2-rated operating systems do you no good if someone writes a critical password on a desk calendar. But if you combine good administrative security with good technical security tools, you can keep your data safe against both innocent mistakes and serious threats. □

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Software Distributors: The Electronic Way

New products promise to ease software distribution by electronically sending upgrades to client PCs.

By Gary Frenkel

Instead of waiting the usual six to eight weeks to receive software, imagine sitting down in front of your computer, filling out an electronic form, and having your new software package automatically installed on your computer within 48 hours. This is the future that electronic software distribution (ESD) promises.

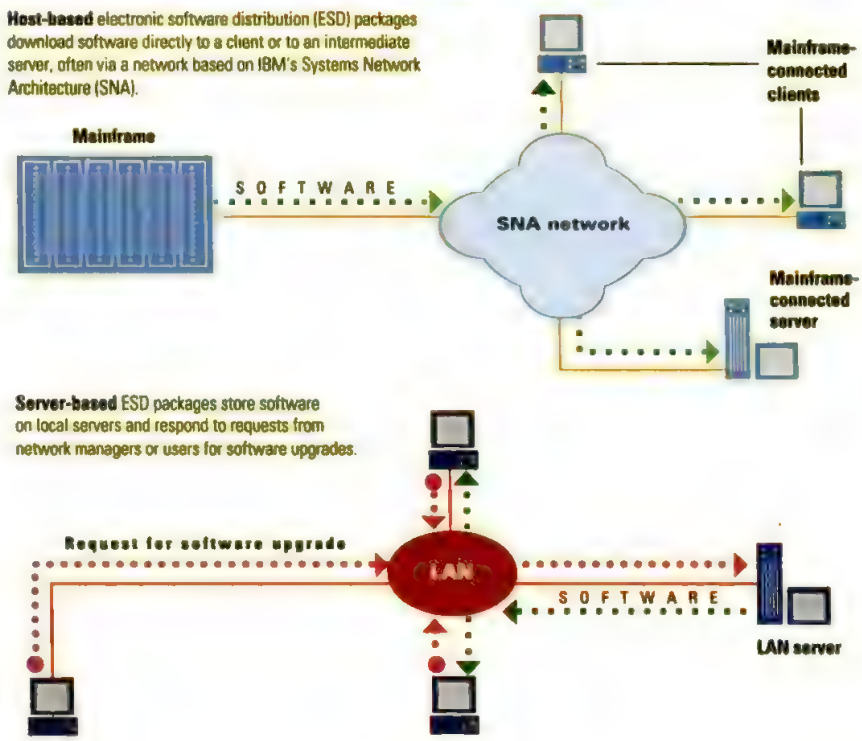
Products that aid electronic software distribution have been around for a while, but this past year produced a flutter of activity, including a heightened interest from LAN operating system vendors. Add to this the trend of software distributors and vendors providing electronic licenses and their concomitant need to track and meter those licenses, and it quickly becomes apparent that within the next couple of years, the way that we purchase and receive software is going to change dramatically. Some of these changes will result in lower prices; less costly, time-consuming, and difficult software maintenance; and faster delivery of new and upgraded software. And the easier the legal acquisition of software becomes, the less attractive software piracy will look.

The early crop of ESD products were primarily mainframe and minicomputer applications that were used to distribute new or updated in-house software to remote users. They performed simple file transfers, often in the form of e-mail or bulletin boards, but left the responsibility of actually installing the software to the user.

Today's ESD products not only distribute in-house applications but can be used to manage the distribution and installation of commercial software as well. Often, companies are reluctant to install upgrades because of the difficulty involved in figuring out which users actually need them and the time needed to install the upgrade on each machine manually. Some ESD systems are able to query machines on the network and build their own inventory databases of installed hardware and software. Others can interface with other network inventorying software. With the data in these inventory databases, applying upgrades becomes a snap. This inventory data can also provide valuable management information for contract negotiation or licensing compliance.

Not only can ESD systems cut down procurement time, they can also potentially save corporations millions of dollars in software maintenance costs. Studies conducted by the Gartner Group and others have estimated that over a LAN's five-year life cycle, software upgrade and support costs on a 2,000-node LAN approach $21,000 per PC. Of this $21,000, only 9 percent is attributable to actual software costs; over 34 percent is spent on software distribution and installation. Although these costs can never be totally eliminat-

Software Distribution Architectures



Software Distribution Systems

Company	Product	Server	Client	Network support
Destiny Technology Corp. 914-923-4307	Deliveryman	OS/2	DOS, OS/2, Unix, Windows,	LAN Manager, LAN Server, NetBIOS, NetWare, TCP/IP, VINES
Frye Computer Systems 617-451-5400	Software Update and Distribution System	DOS, OS/2, Unix	DOS, OS/2, Windows	LAN Manager, LAN Server, NetBIOS, NetWare, TCP/IP, VINES
Hewlett-Packard Co. 415-857-1501	Distributed Update and Install	Unix	Unix	TCP/IP
IBM Networking Systems 914-642-5474	NetVIEW Distribution Manager for MVS NetVIEW Distribution Manager/2 2.0	MVS OS/2	DOS, OS/2, Unix, Windows	LAN Server, NetWare, SNA LAN Server, NetWare, SNA
NCR Corp. 908-576-3710	StarSentry Software Manager	DOS, OS/2, Unix, Windows	DOS, OS/2, Unix, Windows	LAN Manager, NetWare, SNA, TCP/IP
Novell Inc. 303-444-3494	Network Navigator MVS/VTAM Dispatcher Network Navigator VM Dispatcher Network Navigator Tandem Dispatcher Network Navigator LAN Distributor NetWare Navigator	MVS VM Tandem DOS, OS/2 NetWare	DOS, OS/2, Windows DOS, OS/2, Windows DOS, OS/2, Windows DOS, OS/2, Windows DOS, OS/2, Windows	DECnet, LAN Manager, LAN Server, NetBIOS, NetWare, SNA, TCP/IP, VINES DECnet, LAN Manager, LAN Server, NetBIOS, NetWare, SNA, TCP/IP, VINES DECnet, LAN Manager, LAN Server, NetBIOS, NetWare, SNA, TCP/IP, VINES DECnet, LAN Manager, LAN Server, NetBIOS, NetWare, SNA, TCP/IP, VINES DECnet, LAN Manager, LAN Server, NetBIOS, NetWare, SNA, TCP/IP, VINES
Software Spectrum 214-840-6600	Diamond	DOS, OS/2, Unix, Windows	DOS, OS/2, Windows	LAN Manager, LAN Server, NetBIOS, NetWare, SNA, TCP/IP, VINES
Systems Center 703-264-8000	AM·PM 4	MVS	DOS, Macintosh, OS/2, Windows	AppleTalk, LAN Manager, LAN Server, NetBIOS, NetWare, SNA, TCP/IP
Telepartner International 800-935-3270	Synchrony, Version 2.3	MVS	DOS, OS/2, Windows	LAN Manager, LAN Server, NetBIOS, NetWare, SNA
Trik 617-933-8810	NetDistributor Pro	Macintosh	Macintosh	AppleTalk
XcelleNet Inc. 404-804-8100	RemoteWare Communications Management System	OS/2	DOS, Macintosh, OS/2, Unix, Windows	DECnet, LAN Manager, LAN Server, NetBIOS, NetWare, SNA, VINES

ed, even cutting them in half would result in significant savings. In fact, the savings offered by an ESD system can be a significant factor in justifying the cost of installing a LAN.

ARCHITECTURES

ESD systems fall into two basic categories: host-based and server-based. Host-based systems use mainframe disk storage as software repositories. Using the mainframe network, usually based on IBM's Systems Network Architecture (SNA) networking scheme, these systems can distribute software directly to host-attached workstations or to LAN-based servers that can store it for later installation on the workstations. Because these systems can interface with mainframe change-management systems, which track upgrades and updates to both hardware and software and provide version control for in-house developed software, they can be used to distribute software updates automatically and to distribute rapidly changing data, such as new rate tables, to remote sites.

One example of such a product is Novell's Network Navigator. Originally developed as a host-based system by Annatek Systems of Boulder, Colorado, Network Navigator supports products for various mainframes, as well as for DOS and OS/2 servers. Each client machine runs a scheduler TSR (terminate and stay resident) program that initiates downloads of scripts and software from the host- or LAN-based server. These scripts must be written for each application and tailored for various end user hardware and software configurations. Network Navigator does not have a mechanism for querying the hardware and software configuration of the target machine to build an inventory or verify that a suitable environment exists for the new application, nor does it interface with any network-configuration management system.

Both versions of Navigator can take information directly from NetWare's bindery—the directory of users and user groups.

But for distributing commercial software, mainframe-based systems offer no real gain. LAN server-based systems are generally less expensive and offer all of the features that are found on host-based systems.

Novell is also working on a version of Network Navigator that will run as a NetWare Loadable Module (NLM) on NetWare 3.*x* and 4.*x* file servers. The new NetWare Navigator, which is expected to be released by the time you read this, offers updates that can be initiated from the server or a Windows-based console and hooks into the NetWare Management System for configuration management.

Both versions of Navigator can take information directly from NetWare's bindery—the directory of users and user groups. Network Navigator server versions list at $1,000 per five users, with the mainframe versions ranging from $20,000 to $50,000 per host plus $200 for the client software.

Frye Computer Systems' Software Update and Distribution System (SUDS) not only offers all of the necessary ESD features, it is also an excellent network management tool. SUDS maintains an inventory of all hardware and software on

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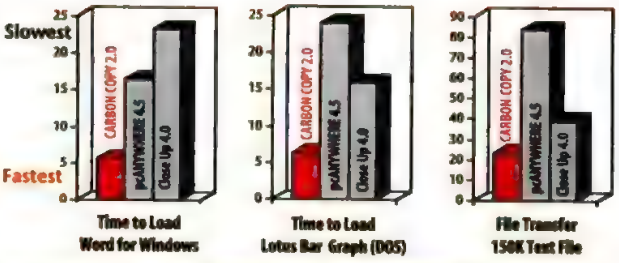

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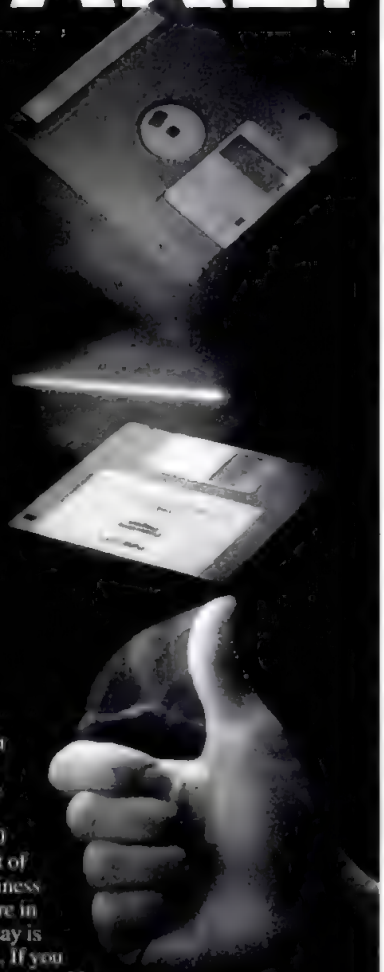

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the network by polling each system as it logs on. Using this inventory, SUDS can easily deliver and install automatic upgrades to all necessary systems and can also monitor and make changes to any specified system-configuration files, such as CONFIG.SYS or WIN.INI. Similar to Network Navigator, SUDS uses user-defined scripts to install software automatically. Frye provides a third-party macro language to create these scripts. SUDS can be integrated with other Frye Utilities for Networks products to provide a full suite of integrated network management functions.

As part of its Windows NT push, Microsoft has introduced a comprehensive network-management package called Hermes. Hermes, which will be sold separately from NT, will combine software inventorying, distribution, and metering (tracking the software's use). The software will automatically inventory hardware and software on each PC that logs onto the network and then store the information in a SQL database. Hermes will remotely install software on user's machines based upon predefined criteria, such as the business group to which a user belongs.

Prices range widely for these LAN server–based systems, from SUDS at $995 for 50 users to Destiny Deliveryman and Novell's $1,000 per 5 users to XcelleNet RemoteWare at $12,000 per server and $220 to $500 per client.

With Microsoft's upcoming Hermes for LAN Manager–based networks, Novell's NetWare Navigator, and IBM's NetView Distribution Manager /2 for LAN Server networks, it appears as if ESD will soon become part of the network operating system. Although this is a step in the right direction, ESD has the potential to become another front in the standards wars.

ESD FROM THE VENDOR

Keep in mind that the software distribution and installation facilities that are offered by today's products are only part of the ESD picture. Full ESD must provide a solution from the vendor to the desktop. This includes on-line ordering, electronic distribution of software or upgrades from the vendor or distributor, and the tracking and metering of licenses.

For all of this to happen, new standard interfaces need to be further developed and accepted. The Software Publishers Association is overseeing the development of a license server application programming interface to facilitate the deployment and management of electronic licenses. Once this API is accepted as a standard, vendors will have to comply with it.

In order to facilitate proper installation across a wide variety of hardware and software configurations, ESD vendors might be able to take advantage of the fledgling Desktop Management Task Force's Desktop Management Interface (DMI). DMI will provide a standard way to manage all of the hardware devices on a network (see "Across the Network Management Gap" *PC Magazine: Network Edition*, July 1993).

Today's LAN inventory products do a good job of reporting on memory configuration and the types of graphics resolution that are supported by certain products, but they cannot report back on specific information about all of the components installed in a PC. This information is crucial for ESD systems to be able to configure the software that they automatically install.

Software distributors are beginning to adapt to this new method of doing business. Egghead Software has introduced Egghead Express, its electronic ordering system, and plans to deliver an ESD system sometime later this year. Corporate Software and others are examining the possibility of distributing CD-based software listings, from which customers will be able to order and purchase. InfoNow Corp. in Boulder, Colorado, allows corporate customers to download software from an electronic store. Systems based on workflow automation, as well as custom packages (such as a specialized ordering system) being developed by corporations themselves will need to interface with one another in order for ESD to work. The potential savings in both time and shipping and handling costs are obvious, but it will take a level of cooperation that is not necessarily characteristic of our industry. Let's hope we can all meet the challenge.

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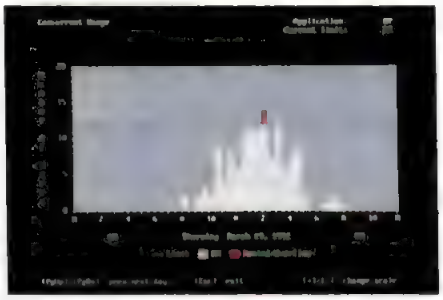

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System Requirements: AppMeter meters both DOS and Windows applications. Requires Novell NetWare 2.1x or above, or NetWare 386. Includes VAP and NLM. No TSR required.

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FIRST LOOKS

HANDS-ON EVALUATIONS OF THE NEWEST NETWORK PRODUCTS

NETWORK OPERATING SYSTEMS

Microsoft Windows NT Advanced Server: Lots of Potential, Early Snags

BY GARY GUNNERSON

At first glance, Microsoft Windows NT Advanced Server seems to accomplish the impossible: blending the look and feel of Windows and the power of NT with the sophistication of an enterprise network operating system at a fraction of its competitors' prices.

Certainly, Microsoft does deliver on many of its initial promises. With Advanced Server, users get simplified multiserver management; enhanced connectivity in the form of support for Macintoshes, NetWare clients, and up to 64 remote users (NT is limited to one remote user); improved data reliability in the form of Redundant Array of Inexpensive Disks (RAID) technology; and beefed-up application performance through support for four processors (versus NT's two processors). All this is provided for a price of just $2,995 per server (Microsoft will offer Advanced Server for an introductory price of $1,495 until February, 1994).

Yet, as with any project as aggressive as a new network operating system, the actual implementation differs from the promises. Most disturbing were the bugs we encountered when configuring Advanced Server for Macintosh, Unix, and NetWare clients. When equipped with the necessary protocols and multiple adapters, the server would alternately crash, lose icons, or simply not work. Even without these driver problems, though, Advanced Server's flat security model makes managing a large, multiserver network either difficult or slow.

After evaluating the manageability, reliability, connectivity (we did not look at RAS, Microsoft's remote communications add-on), and file-server performance of Advanced Server, we were still left with problems that will only be resolved through further testing and bug fixes. One thing is clear, though: While Advanced Server may make

continues on NE20

Windows NT: Workstation vs. Advanced Server

	Windows NT Workstation	Windows NT Advanced Server
Server support	Single server	Multiple servers
Access rights	Single server	Multiple domains
RAID support	RAID 0	RAID 1, 5
Directory replication	Import	Import, export
Macintosh services	No	Yes
Remote-access services	1 user	64 users
NetWare client support	None	Applications only
List price	$495 per workstation	$2,995 per server ($1,495 until 2/94)

STORAGE MANAGEMENT

Conner HSM Safeguards Your Data

BY STEVE RIGNEY

Many corporations are committed to downsizing from mainframe-based systems to PC networks. But as the computers get smaller, the data storage needs mushroom. Conner Peripherals' Hierarchical Storage Management (HSM) applies a mainframe data-management strategy to storage technology for NetWare networks.

Conner's HSM is the first hierarchical storage management system for enterprise-wide NetWare networks. It allows you to store up to 70 gigabytes (GB) of data using a combination of storage devices—including hard disks, optical jukeboxes (which hold up to 16 magneto-optical cartridges), and tape libraries—and data-management software. With a retail price of $7,500 for a two file server–license, however, the HSM is only economical if you need to store very large amounts of data (10GB or more).

Traditionally, HSM has been seen only in mainframe environments. It provides different types of storage media with in-

continues on NE27

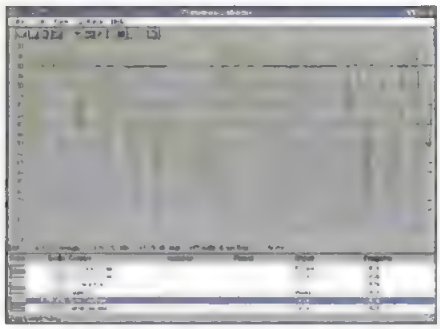
Windows NT

CONTINUED FROM PAGE NE19

inroads as a strong application server, performance tests show that relatively poor file service limits its ability to compete with NetWare as the file server of choice.

MULTISERVER MANAGEMENT

The improvements in network management are by far the most important changes that Advanced Server makes to NT. A slew of Windows utilities are provided to manage a server, and a log is kept of all events that occur at the server. Beyond these individual utilities, though, Advanced Server makes major enhancements to network management.



SIDE BY SIDE: Performance Monitor tracks the status of multiple processors.

Under NT, each server is separate, forcing users to log on to every server they need to use—an approach that becomes unwieldy very quickly.

Advanced Server gets around this problem by grouping servers together to form *domains*. Each server within a domain uses the same set of user accounts, copied from a special server called the Domain Controller, so that users can log on to any server from any client within the domain. Each domain has its own Domain Controller.

Users in other domains can log on to the network through *trusts*. Under a trusted relationship, the local Domain Controller validates a user by checking the user lists of other Domain Controllers. Once a trusted relationship is set among two or more domains, user accounts can be treated with the same capabilities, rights, and permissions.

Domains are crucial, particularly in networks of hundreds of servers. However, it is precisely in these networks that Microsoft's domain architecture begins to falter, for network managers must choose between performance and ease of management. The degree to which either of these factors is an overriding consideration will help determine which of Microsoft's four domain models is best to implement.

The easiest model to manage is the Single Domain, which contains all stations. Here, there are no trusted relationships, so there is little management overhead. But with only one Domain Controller to validate access to a resource, performance will be lower.

A Complete Trust model assumes that user accounts are not maintained from a central entity, so all departments remain autonomous; each maintains its own user accounts. Here, there are trusts between each domain, making management extremely complex. However, by replicating the user-account database across so many servers, performance is also very high.

The Master Domain model creates a centrally controlled domain that maintains all user accounts and global network-wide groups. All other domains serve as resource domains that share file and print resources and utilize the user accounts from the Master Domain. Here, the number of trust relationships that need to be managed is very small, but now a central authority must maintain all the user accounts, which creates additional overhead. With so many users needing access to this server, three servers should be established to maintain respectable performance.

The last model is the Multiple Master Domains, in which duplicate copies of global groups and perhaps local groups must be maintained manually. The administrative burden increases dramatically with this model, because each domain must trust each of the multiple master domains, and the master domains must also trust each other.

A hierarchy of domains would simplify the Multiple Master Domains, reducing the number of trust relationships required and the administrative burden of copying global groups among the multiple masters. Microsoft could easily create a process that would maintain global groups, automatically extending its domain/trust model to the largest enterprises.

ENHANCED CONNECTIVITY

Of course, after performing mental gymnastics designing trust relationships, you still need to actually *use* Advanced Server. Users access files and resources on Advanced Server through any number of clients, including Macintosh, Windows, Unix, OS/2, and—of course—DOS machines. As for other network operating systems, NetWare, LAN Manager, and LAN Server client support is targeted by Advanced Server.

Apple Macintosh services were a pleasant surprise. Initially, the Mac services show up as a "Microsoft UAM Volume" on the Mac client. User Authenti-

continues on NE22

Does Windows NT Advanced Server Deliver On Microsoft's Promises?

Claims	Realities
Disk recovery	**Yes:** File system logs transactions and recovers from errors
Easy installation	**Yes:** Advanced Server uses auto-sensing to configure the system
Power and scalability	**Yes:** Runs on symmetrical multiprocessing and high-end workstations
Macintosh services	**Yes:** Full Macintosh services
Enterprise management	**Limited:** No hierarchical structure.
Fault tolerance	**Limited:** No server mirroring, UPS, or RAID support.
NetWare client support	**Limited:** Works as an application server, not as a file server
Multiclient support	**Limited:** File and print services are not offered for Unix clients
Easy management	**Limited:** Management of multiple client types is sometimes confusing
Native client/server applications	**Limited:** Virus protection, file archiving, file migration, and third-party client/server applications and gateways are currently not available
Application integration	**Limited:** Mail and schedule applications will not read user accounts from Advanced Server

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KUR-0021

Windows NT

CONTINUED FROM PAGE NE20

cation Modules let the Mac use a secure log-on to Advanced Server. Options on the Advanced Server let you tighten security to allow only Microsoft-secure log-ons from Macs. Advanced Server showed some inconsistencies with the way volume locks are handled between File Transfer Protocol (FTP) and Macintosh services. A single utility that controls volume access or implements these features strictly within File Manager would make the most sense.

Ironically, Apple's AppleTalk is the only protocol that can be routed or bridged between LANs. All other protocols, such as TCP/IP, NetBEUI, NetBIOS DLC, and IPX/SPX, are supported as transport protocols only, without any routing convenience.

Printing to an HP LaserJet III without PostScript worked very well from the Macintosh. A PostScript raster-image processor within the Macintosh services converts PostScript from the Apple to PCL on the LaserJet. This feature in itself, running on a RISC processor, could enamor a multitude of Macintosh shops with Microsoft.

Unix support remains limited to what NT provides, namely FTP and TELNET terminal services from the server and FTP services to the server. Third parties should supply network file system support in the near future. A UnixWare client easily moved files with FTP to and from Advanced Server. Open FTP services, however, could compromise the C2 security of Advanced Server by allowing access to the disk drive from an unsecure workstation and should be avoided for those desiring stringent security. Stick with Unix servers if you need these services.

IN A BIND: Centralized management simplifies the binding of transfer protocols to adapters.

MIGRATION PATH

Migration from LAN Manager or LAN Server clearly makes sense. Advanced Server supports these environments cleanly and effectively. NetWare, however, is a different story. Currently, there is no NetWare requester for NT, so we couldn't see how an NT client would access the NetWare server. As for acting as a NetWare server, NWLink does not implement Novell's NetWare Core Protocol (NCP), the protocol it needs to function as a file server. Client/server applications that write directly to IPX or SPX, however, are supported.

What's more, it was only when installing NWLink in a server with multiple adapters—a standard technique utilized to improve network performance—that we found all sorts of problems. Problems occurred inconsistently with NWLink, crashing the server, removing Macintosh icons, and causing FTP or TCP/IP services to fail. However, further testing showed that NWLink may not have been at fault in this case: We were also unable to get NetBEUI, TCP/IP, Mac services, and FTP to work effectively. Switching from Ethernet to Token-Ring adapters had little effect. With Proteon Token-Ring adapters installed we still ran into all sorts of driver problems.

As a file server though, there's no question: Advanced Server is a decidedly poorer performer than NetWare 3.11 or 4.0 equipped with Novell's Packet Burst protocol. When reading a 4MB file, for example, NetWare 3.11 and 4.0 doubled the performance of Advanced Server on 512, 1K, and 1.5K frames. At 4K frames, 3.11 and 4.0 were still 30 percent faster than Advanced Server.

On paper—and even in practice—Advanced Server promises to become a powerful application server. Like any first release, however, bugs need to be corrected before the product can reach its full potential. As a file server and as replacement to NetWare, Advanced Server has a long way to go. Still, many sites will find its strong Macintosh support blended with the other facilities of NT a very attractive solution, but users would be well-advised to wait until Microsoft works out the problems in Advanced Server drivers.

• List price: *Windows NT Advanced Server, introductory price, $1,495; after February 1994, $2,995. Workgroup Connection, $175 for first five DOS/-Windows clients, $33 per additional DOS/Windows client. Windows NT and Windows for Workgroups include built-in client support. Microsoft Corp., One Microsoft Way, Redmond, WA 98052-6399; 800-426-9400, 206-882-8080; fax, 206-883-8101.*

Additional testing for this review was done by Constantine Fotopoulos, a Technical Analyst with PC Labs.

Windows NT Advanced Server vs. NetWare 3.11/4.0

	Windows NT Advanced Server	NetWare 3.11/4.0
Ease of installation	Quite easy	Difficult
Network management	Many GUI tools	Well-known character-based tool (3.11), integrated Windows tool (4.0)
Fault tolerance	RAID Levels 1 and 5, UPS	RAID Levels 1 and 5 (third-party), System Fault Tolerant III, UPS
Directory services	Domains and trusts	Domains (3.11), X.500 model (4.0)
Routed protocols	AppleTalk	AppleTalk (add-on), IP, IPX
Symmetrical multiprocessing	Yes	No
32-bit operating system	Yes	Yes
Memory protection	Protected mode	Automatic page-fault detection, partial-protected mode
Disk recovery	Automatic	Manual (automatic with add-on only)
NetWare client support	Limited, no file and print services	Full
Peer-to-peer services	Yes	No
List price	$2,995 (unlimited users), $1,495 until 2/94	3.11, $5,995 (50 users); 4.0, $6,295

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hardware assets. Information that can also be centrally viewed using Intel's LANDesk™ Manager software.

The FlashC adapter even includes Intel FlashVirusProtect†, which detects and corrects boot sector viruses, and guards against thousands of viruses on your PCs—from system memory to files stored on floppy and hard disks.

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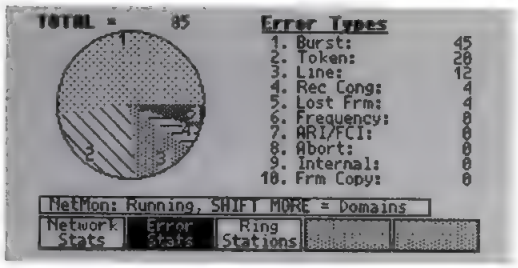

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Tools for Healthier LANs

FLUKE.

CIRCLE 925 ON READER SERVICE CARD

Conner

CONTINUED FROM PAGE NE19

creasingly greater capacity and lower cost, but these rewards are tempered by longer retrieval times. HSM moves inactive files from high-speed SCSI drives to optical drives, and finally to a DAT or 8-mm drives.

Conner's optical jukebox.

Conner's HSM software requires a great deal of hardware, including a NetWare 3.11 file server with two 300MB or larger SCSI hard disks, an Adaptec SCSI controller, a Conner or HP magneto-optical jukebox or a tape library, and a high-capacity DAT or 8-mm tape-backup device.

Installation requires several hours and a strong practical knowledge of NetWare, SCSI devices, and data-storage systems. Once installed, however, the software is very easy to use and administer. HSM is installed on a NetWare LAN as a dedicated storage server. The system is not designed to take the place of a NetWare file server, only to store your existing file server's overflow.

The Automatic File Migration feature allows you to set predefined critical, acceptable, and optimal levels for the disk storage space on the file server. If the file server's hard disk reaches or exceeds these levels, an automatic file migration takes place.

The software searches file-access dates on your server for an archive bit in order to ensure that each file has been previously backed up. If a file has not been used recently or specifically excluded from migration and it meets all of the other requirements, that file is copied to the HSM storage server. A 420-byte placeholder file is left in place of the original file.

Once a file reaches the storage server, the hierarchical management comes into play. The file is stored on a pair of mirrored hard disks. The storage server's hard disks are divided into three volumes. Once the first volume reaches its capacity, the data is transferred to the second volume, where it's backed up to the tape drive. When the second is full, the data is transferred to the third volume, from which it moves to the optical jukebox or tape library.

Because of the placeholder files, users can call files without having to know where they reside. Each NetWare file server loads an NLM that allows the server to find and retrieve any file. Each client PC must also load a small (4K) TSR (terminate and stay resident) program for this purpose. If the migrated file is still on the HSM SCSI hard disk, recall is instantaneous. If the migrated file is stored on the optical or tape drives, recall can take as long as 8 seconds or several minutes.

Conner's HSM succeeds in providing an efficient method of handling data in large networks. Because of its price, it is only suitable for large NetWare environments with very high-end storage requirements, but it provides an invaluable service in those situations.

• List price: *Conner HSM, $7,500. Conner Peripherals, 36 Skyline Dr., Lake Mary, FL 32746; 800-541-2220; fax, 407-263-3638.*

Circle 966 on reader service card

Driver Alert

The following table lists recently released software drivers and utilities from Standard Microsystems Corp. (SMC). This software can be obtained from Library 9 (SOS Driver Alert) the Utilities/Tips Forum on ZiffNet. A complete source of network technical-support information including technical articles, documentation, and supplemental software from leading manufacturers and software publishers can be found in Support On Site, the monthly CD-ROM published by Computer Library. For more information call 212-503-4400.

File name	Size (kilobytes)	Release date	Description
ES53D.EXE	537	07/19/93	EtherCard Elite Ultra SuperDisk drivers, Version 5.3: Includes drivers for NDIS, NetWare, ODI, and Windows NT.
ES53S.EXE	227	07/19/93	EtherCard Elite Ultra SuperDisk EZStart, Version 5.3: Automates driver installation; automatically configures SMC Ethernet adapters. Supports EtherCard Elite Ultra and Plus adapters with 83c690 chip.
TRI103.EXE	33	07/13/93	TokenCard Elite series, Microcode, Version 1.03: Contains DOS and OS/2 TRINIT code (which must be loaded before any other network drivers). For use with 8- and 16-bit EtherCard Elite–series adapters.
EN2604.EXE	83	07/12/93	Elite Ethernet driver NW 286 2.1x/2.2: Contains NetWare 2.1x/2.2 server/workstation drivers for use with SMC 8- and 16-bit EtherCard Elite–series adapters.
EN3500.EXE	21	07/12/93	Elite-series Ethernet driver NW 386 3.1x: NetWare 386 3.1x server driver for use with SMC 8- and 16-bit EtherCard Elite–series adapters.
NAD500.EXE	13	07/12/93	Elite series Ethernet Address Display: For use with all former Western Digital Ethernet adapters as well as SMC 8- and 16-bit EtherCard Elite series adapters.
TND104.EXE	188	07/12/93	TokenCard Elite–series NDIS drivers, Version 1.04: Contains DOS and OS/2 NDIS drivers for use with SMC TokenCard Elite–series adapters.
30XX11.EXE	416	07/02/93	SMC3000 Series Ethernet Superdisk, Version 1.1: Includes support for FTP Workstation, NDIS, NetBIOS, Novell IPX and ODI drivers, and Win/TCP Workstation.
ARC32.EXE	408	07/02/93	ARCnet drivers, Version 3.02: Includes server and workstation ODI drivers for SMC ARCnet adapters (except the PC500 short card). Also includes NDIS, NetBIOS, and NetWare 2.1x/3.1x support.
ARCODI.EXE	19	07/02/93	ARCnet NetWare 3.11 ODI drivers: Contains server and workstation ODI drivers for Micro Channel, PC500 Long Board, and PC600.
E32147.EXE	82	07/02/93	Elite 32 NetWare 3.11 ODI driver, Version 1.47: SMC Elite 32 (8033) Ethernet Dual Channel Network Adapter Driver for NetWare 3.11. Includes DOS ODI workstation driver.
ETHODI.EXE	17	07/02/93	3016/3008 ODI driver: NetWare 3.11 ODI drivers for the SMC3000 series of network adapters.
FTP230.EXE	17	07/02/93	FTP packet driver, Version 2.30: For the 3008, 3016, and 3016MC cards.

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▶DRIVE ARRAY SUBSYSTEM

Stacking Up RAID Storage for NetWare

BY JAMES KARNEY

Micropolis's Raidion LT for NetWare offers either Level 1 (disk mirroring) or Level 5 (parity) RAID storage with a capacity of up to 65 gigabytes (GB), providing an easy-to-install, expandable RAID subsystem for your NetWare LAN.

FORM AND FUNCTION: The Raidion LT is sleek in appearance as well as functionality.

The first thing you'll notice about the Raidion LT, which was originally only available for OS/2 and LAN Server, is its well-designed enclosure. The beauty of the design is more than just skin deep, however, as each drive is enclosed in a metal case covered by a stylish plastic outer shell. Each case has its own cooling fan, power jack, and the ability to connect to another drive or host adapter, or to terminate a SCSI chain. Adding another drive to an array is as simple as snapping the new unit on top of the stack and connecting its cables. Replacing a failed drive module is just as easy.

The Raidion LT's hardware is a combination of Micropolis drives and cases, combined with Adaptec host adapters, while the RAID itself is a software solution, tailored to the hardware. For Level 1 RAID, the Raidion LT can be configured with as few as two drives and one host adapter. For Level 5 RAID, the software shares parity information across all the disks in the subsystem, offering security that is more effective than mirroring: If one drive fails, the others can restore to a replacement without downing the server or losing data. The Raidion LT requires at least three drives and a single host adapter for a Level 5 configuration.

The Raidion LT supports both hot-swapping and the use of on-line spare drives. The on-line spare solution requires at least four drives, one of which is the standby. If a drive fails, the server automatically begins reconstruction and broadcasts a notice to the supervisor concerning the current status. As long as two drives do not fail at the same time, no data is lost.

Installation was easy. After installing six 545MB Micropolis 2105 Fast-SCSI-2 drives and three Adaptec 1742 host adapters, we loaded the Raidion NetWare Loadable Module (NLM) on our NetWare 3.11 server and configured Level 5 RAID. The setup routine automatically set up the drives and loaded the files. We used one drive as an on-line standby and populated the volume with 500MB of programs and files.

When we opened one of the bays and pulled a drive, we were pleased to see that the on-line spare worked as advertised. By the time we returned to the workstation, the server had broadcast a notice to the supervisor and the repair was underway. The Raidion's performance is equally impressive. In fact, we found the average variance in performance between the server-attached Raidion LT and a locally attached 2105 drive to be less than 2 percent. The Raidion LT for NetWare is an excellent RAID solution, and the hardware enclosure is the easiest on the market to set up and expand. Micropolis even offers toll-free technical support—with call-back service on weekends.

• List price: *Raidion LT for NetWare, from $4,100, depending on hardware configuration. Micropolis, 21211 Nordoff St., Chatsworth, CA 91311; 818-709-3300; fax, 818-709-3396.*

Circle 968 on reader service card

▶ELECTRONIC MAIL

a la mode Offers Inexpensive E-Mail

BY STEVE RIGNEY

a la mode workgroup systems' a la mail, Version 2.0, combines e-mail with useful workflow automation features. The program does not require a dedicated e-mail server and works with any networked PCs running Windows.

a la mail, priced at $595, provides the same basic message handling functions found in the more expensive LAN e-mail packages such as cc:Mail and Microsoft Mail. The program also provides message encryption, private and shared message folders, multiple attachments, message templates, an ASCII message editor, and a spelling checker, as well as a laptop mode that allows you to create e-mail messages without being connected to the LAN (unfortunately, a la mail does not offer a remote-access e-mail module, so you can't send these messages until you are back at your network workstation).

You can install and set up both the network post office and individual e-mail workstations in minutes, then add or change user, group, and global user information using a password-protected maintenance utility.

Like other e-mail platforms, such as cc:Mail, a la mail allows you to assign attachments to your mail message. These attachments can be set to execute automatically upon receipt of the message. You could attach a Word for Windows document that would launch Word when the message was read. A single message can have as many as 50 attachments.

One of the most useful features is the $95 Multi-user Network Fax Gateway, with which you can send a fax across the network to another PC that has an internal or external fax modem and Windows-

Continues on page NE34

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a la mode

CONTINUED FROM PAGE NE30

compatible fax software. This feature gives you the benefit of a network fax server without dedicating a PC or investing in expensive fax server software.

Although a la mail does not support the Message Handling Service (MHS) or Microsoft Application Programming Interface (MAPI) protocols for sending e-mail across gateways, as do other Windows-based e-mail packages such as Microsoft Mail and BeyondMail, it does include proprietary protocols for this task.

The OMF (Open Message Format) and GAPI (Gateway Application Programming Interface) protocols allow users to create mail using any DOS text editor and send it across a gateway to other mail systems. OMF is a simple message structure accessible to any program that can read or write a simple DOS text file. GAPI provides an interface for writing applications that move data between a la mail messages and other e-mail systems. Future releases will support MHS and MAPI.

a la mail's Advanced Workflow Routing allows you to route specific messages automatically. If a purchase order follows the same route every time, for example, a la mail will remember the route and automatically address and send it.

The a la mail system proves that you can have a full featured e-mail system without spending a lot of time and money. It's ideal for small to medium-sized workgroups that need to send and receive e-mail but don't want to spend thousands of dollars.

• List price: *a la mail, Version 2.0, $595; a la mode workgroup systems, 1015 Waterwood Parkway, Building F, Edmond, OK 73034; 800-252-6633; fax, 405-359-5652.*

Circle 963 on reader service card

▶ADAPTERS

New Low-Cost EtheRx Performs

BY JEFFREY D. BAHER

Fast, 32-bit, bus-mastering EISA adapters are the logical choice for connecting servers to Ethernet networks. Not surprisingly, these cards are generally more expensive than their 16-bit counterparts, ranging anywhere from $400 to $1,000. The Kingston EtheRx LAN adapter, however, challenges the 32-bit bus-mastering market with a list price of only $250.

The EtheRx comes with Novell Open Data-link Interface (ODI) and Microsoft Network Driver Interface Specification (NDIS) drivers, helpful documentation, and a 5-year warranty. The card is available in both dual interface (supporting 10Base5 and 10BaseT) and 3-in-1 (10Base5, 10Base2, and 10BaseT) configurations.

The results of ZD Labs' NetBench, Version 2.06, Network Interface Card (NIC) Throughput test show the EtheRx was 19 to 41 percent faster than the baseline, an Eagle NE3200 32-bit bus-mastering EISA adapter, as a workstation adapter. The EtheRx also outperformed the Eagle as a server card, but at the expense of considerably higher CPU utilization. This is partly because the EtheRx can move more data and therefore utilizes the server's CPU more frequently.

Benchmark Tests: Ethernet Adapters

As a server card, the Kingston EtheRx records higher throughput than the Eagle NE3200—but at the expense of CPU cycles, greatly diminishing its value as a server adapter. The Performance Index, which is equivalent to bandwidth utilization divided by CPU utilization, approximates the effect of an adapter's CPU utilization on the overall performance of the server. This index indicates that the EtheRx's higher throughput is overshadowed by its high CPU utilization. As a result, the Eagle NE3200 receives the more favorable index. The EtheRx's workstation performance is strong, however, and—along with its price—makes the EtheRx a good choice for the desktop.

The **NIC Throughput** test from NetBench 2.06 evaluates the amount of data that an adapter can transfer across the network in 1 second. A PC equipped with the adapter issues a series of read requests to a file stored in the server's cache. The test uses block sizes ranging from 64 bytes to 2K.

NIC THROUGHPUT (SERVER)

Megabits per second

Block size ▶	64 bytes	128 bytes	256 bytes	512 bytes	1K	2K
Eagle NE3200	0.98	1.87	3.13	6.16	8.03	8.04
Kingston EtheRx	2.44	3.88	5.67	7.24	8.41	8.40

Higher scores represent better performance

CPU UTILIZATION

Percent

Block size ▶	64 bytes	128 bytes	256 bytes	512 bytes	1K	2K
Eagle 3200	16.20	15.30	13.70	13.20	9.97	9.97
Kingston EtheRx	54.50	44.60	34.20	23.20	15.00	15.00

Lower scores represent better performance

PERFORMANCE INDEX

Block size ▶	64 bytes	128 bytes	256 bytes	512 bytes	1K	2K
Eagle NE3200	0.60	1.22	2.29	4.67	8.06	8.06
Kingston EtheRx	0.45	0.87	1.66	3.12	5.60	5.60

Higher scores represent better performance

NIC THROUGHPUT (WORKSTATION)

Megabits per second

Block size ▶	64 bytes	128 bytes	256 bytes	512 bytes	1K	2K
Eagle NE3200	0.70	1.24	2.19	3.50	4.92	5.06
Kingston EtheRx	0.99	1.72	2.89	4.37	5.87	6.06

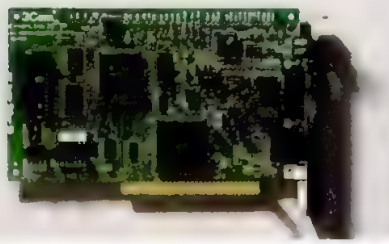
Higher scores represent better performance

But this doesn't explain the whole story: The NE3200 implements an on-board Intel Bus-Master Interface Chip and a 10MHz 80186 CPU to reduce the demand on the host CPU. The EtheRx is not equipped with an on-board processor, so it delivers a less expensive but less efficient bus-mastering

Continues on page NE34

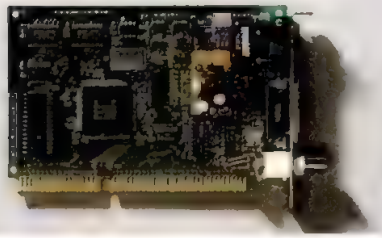
WELCOME TO THE LAN OF OPPORTUNITY.

3 COM ETHERLINK III 3C509-TPO

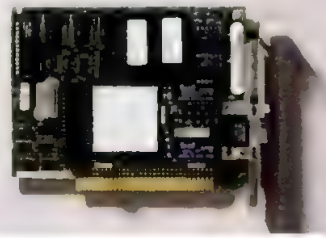


3 COM ETHERLINK III 3C509 COAX

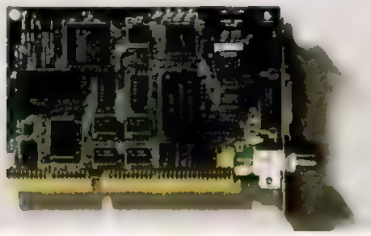
ACCTON ETHERNET COMBO



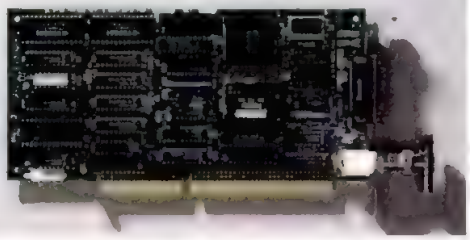
IBM 16/4 TOKEN RING



SMC ETHERCARD PLUS ELITE 16 COMBO



EAGLE NE2000 PLUS 3-ETHERNET



NETWORK INTERFACE CARDS

3 COM ETHERLINK III 3C509-TPO	$124	3 COM ETHERLINK III 3C509 COAX	$124
ACCTON ETHERNET COMBO	$ 84	IBM 16/4 TOKEN RING	$465
SMC ETHERCARD PLUS ELITE 16 COMBO	$134	EAGLE NE2000 PLUS 3-ETHERNET	$124

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EtheRx

CONTINUED FROM PAGE NE32

solution in terms of host CPU utilization.

The EtheRx's high CPU utilization makes it a poor candidate for a CPU-intensive server environment or a multisegment server environment, where multiple server adapters are required. Peak performance will probably be realized in a single-segment server with low-level CPU activity.

Overall, the EtheRx is a welcome addition to the 32-bit bus-mastering Ethernet market. Although it lacks the versatility expected from this type of card, it delivers solid workstation performance and respectable single-segment server performance at an unprecedented price.

• List price: *Kingston EtheRx Ethernet Adapter, dual interface (10Base5 and 10BaseT), $250; 3-in-1 interface (10Base5, 10Base2, and 10BaseT), $295; Kingston Technology Corp., 17600 Newhope St., Fountain Valley, CA 92708; 714-435-2600; fax, 714-435-2699.*

Circle 969 on reader service card

CORRECTIONS AND AMPLIFICATIONS

In our First Looks review of Intel's EtherExpress FlashC Adapter (August 1993, page NE38), it was incorrectly reported that the FlashWorks utilities work with NetWare, as well as with Windows for Workgroups, Microsoft LAN Manager, LAN Server, and VINES. In fact, these utilities are currently available only for NetWare.

▶INTELLIGENT HUBS

Asante Unveils Manageable Hub

BY JEFFREY L. CARRELL

So you are installing a 10BaseT Ethernet network. You want future expansion capability and SNMP-based network management. Above all, low cost is the prime motivator. Asante's new intelligent hub, the AsanteHub 2072 and AsanteView, Version 2.2 management software for Windows or Macintosh, exceeds these requirements.

Asante's latest entry into the hub market is an intelligent, modular workgroup hub that offers many of the features commonly associated only with enterprise hubs—for as little as $83 per port.

UP FRONT: The Asante Hub 's front-access connections simplify troubleshooting.

The 2072 hub has a dual-segment backplane for two completely isolated Ethernet networks in the same chassis. There is also a redundant power supply version of the chassis available for those who need fault tolerance. Currently, modules are available for 10BaseT, Fiber-Optic-Inter-Repeater-Link (FOIRL), and coax Ethernet.

Later this year, Asante will release the AsanteHub 2072 Bridge Module. All modules are hot-swappable, so they can be removed from the chassis without interrupting network operation. The 2072 is also rack-mountable and all connections, power and data, are available on the front panel, which is a plus for installation and easy-access troubleshooting.

AsanteView, Version 2.2, is an SNMP-based management package. AsanteView is available for Windows and Macintosh platforms, and it can perform both in-band and out-of-band management. With this revision, AsanteView can now manage Asante's 1012 and 2072 hubs as well as the Asante bridges. You can also compile the Asante management information bases into any other management software platform.

AsanteView operates around the panel view, which displays the front-panel LEDs of the hub in real time. In the panel view, there is also a menu button for each module that is used to select which Ethernet segment each module will operate on, see statistics, enable/disable the module and/or its ports, and reset the module.

AsanteView also provides security. You can block users from accessing the network by designating certain ports only for authorized nodes. You can also display various type of graphs, showing performance statistics, packet distribution, and general utilization of the hub or module.

Asante's documentation is good, though it could use some clean-up work. A manual titled *Asante Network Fundamentals,* which covers general Ethernet networking theory, is included with AsanteView. Also, each hub module comes with its own operations and installation guide.

AsanteView running on a Windows platform performs well, despite the fact that it is not based on any other management platform, such as Novell NMS or HP OpenView. The GUI is not consistent across all different views, but overall the data is well-presented. The Windows panel views are closer to the actual module front panels than in the Macintosh version.

The AsanteHub offers both expandability and manageability for a low per node cost. These products provide enterprise features for a workgroup price.

• List price: *AsanteHub 2072, $1,09 Asante Multiport Repeater Modules fro $819 to $2,649; Asante Network Ma agement Module, $1,149; AsanteVie Version 2.2 for Windows or Macintos $1,299; Asante Technologies Inc., 821 F Lane, San Jose, CA 95131; 800-662-96 408-435-8388; fax, 408-432-7511.*

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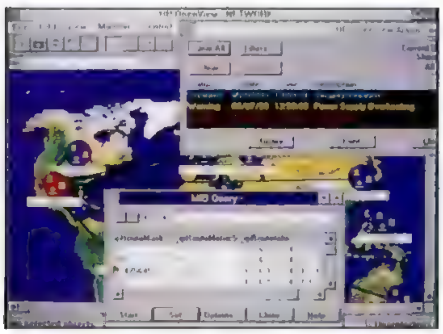
NEW & IMPROVED

NEWS OF ANNOUNCED NETWORK PRODUCTS AND UPGRADES

IMPROVED

HP Adds Functionality to SNMP Management

Hewlett-Packard is now shipping the latest enhancements to its management software platform, HP OpenView for Windows. The new capabilities in Version 7.1 include an enhanced graphical user interface and a status and tool bar. Added support for the Internet Packet Exchange (IPX) protocol allows network administrators to work with both the TCP/IP and IPX protocols. In addition, the network administrators can create a network map to monitor network events and alarms.



WHAT A VIEW: HP OpenView for Windows displays a hierarchical network map.

HP OpenView for Windows, Version 7.1, includes auto-discovery—the ability to locate devices on a network—and layout. Another new feature, the Simple Network Management Protocol (SNMP) Manager, includes a management information base (MIB) compiler and the ability to perform MIB browsing, polling, and graphing.

HP is also offering an application builder as an option to HP OpenView, allowing users to develop applications quickly and easily.

• List price: *HP OpenView for Windows, Version 7.1, $2,500; Application Builder, $1,000. Hewlett-Packard Co., 974 E. Arques Ave., P.O. Box 3486, Sunnyvale, CA 94086-3486; 800-554-1305, 408-720-3000; fax, 408-720-4024.*
Circle 952 on reader service card

IMPROVED

Novell Enhances Directory Services in NetWare 4.01

With its latest version of NetWare, Novell hopes to provide an all-encompassing platform for building a global network. NetWare, Version 4.01, features enhancements to NetWare Directory Services (NDS), a global naming feature that lets users locate network resources no matter where those resources are within the network. The capabilities offer greater network scalability and better internetworking support.

Also, users can now choose from five languages for improved communication and ease of use. NetWare, Version 4.01, includes language software for French, Italian, German, Spanish, and English. Future plans call for language software in Japanese, Korean, Portuguese, and Chinese.

Another enhancement, a five-user stratification of NetWare for Macintosh, Version 4.0, allows Macintosh users to take advantage of the same NetWare benefits available to DOS, Microsoft Windows, OS/2, and Unix users. Added features of NetWare for Macintosh include CD-ROM access, DOS-to-Macintosh application mapping, and optional routing services.

• List price: *NetWare, Version 4.01, free to all registered NetWare 4.0 customers, available in 5-, 10-, 25-, 50-, 100-, 250-, 500-, and 1,000-user configurations. Novell Inc., 122 East 1700 South, Provo, UT 84606-6194; 800-453-1267, 801-429-7000.*
Circle 953 on reader service card

HOT PROSPECT

Symantec Offers Cross-Platform Net Utility

Symantec Corp. lets network managers automate key tasks with The Norton Administrator for Networks, Version 1.0. The utility provides hardware and software inventory upon boot-up, software distribution and workstation management, application metering, and a Windows console. Additional features include an embedded BASIC script language and the ability to create customizable reports, charts, and graphs.

The Norton Administrator addresses the abundant need for utilities that work across multiple platforms and operating systems. Symantec's new strategy provides support for all major network operating systems, including NetWare, VINES, Microsoft LAN Manager, and IBM LAN Server. It also provides increased data security, integrity, and control; network administrators can also plug in The Norton AntiVirus and pcAnywhere remote-control technology.

• List price: *The Norton Administrator for Networks, Version 1.0, $2,728 (50 nodes); $44,000 (1,000 nodes). Symantec Corp., 10201 Torre Ave., Cupertino, CA 95014; 800-441-7234; fax, 408-255-3344.*
Circle 951 on reader service card

NEW

Network General Introduces Analysis for Notebooks

Network General Corp. now offers an affordable and portable solution for analysis of Ethernet or Token-Ring networks. Based on the company's proven Expert Analysis technology, Notebook Sniffer Analyzer is a combination software/board solution. It is the first analysis product to offer support for the PCMCIA Type II standard.

Expert Analysis can provide automatic identification and notification of common network problems that may occur at all seven Open Systems Interconnection (OSI) layers. The software provides diagnostic information by identifying network configurations, then analyzes that information. Network managers can now identify such network problems as slow file transfers, misconfigured routers, and broadcast storms—all on the compact platform of a notebook computer.

• List price: *Notebook Sniffer Analyzer, $9,995. Network General Corp., 4200 Bohannon Dr., Menlo Park, CA 94025; 415-473-2000; fax, 415-321-0855.*
Circle 954 on reader service card

IMPROVED

NCR Adds Support for Help Desk Solution to StarSentry

NCR Corp.'s recent venture with Remedy Corp. bridges the gap between monitoring facilities and global network management processes. Remedy Corp.'s Action Request System (ARS) can now be used with NCR's StarSentry enterprise system running on the NCR 3000. Such an integration provides network managers with help-desk and trouble-ticketing capabilities. Working within a StarSentry application, managers can click on an icon and view trouble tickets, collect information about a device, generate reports about a device, or modify the trouble ticket itself.

BRIDGING THE GAP: Integrates monitoring and response capabilities.

• List price: *Action Request System for NCR 3000, $6,500; StarSentry Systems Manager, $5,500 to $37,500. NCR Corp., 1700 S. Patterson Blvd., Dayton, OH 45479; 800-637-2600. Remedy Corp., 1965 Landings Dr., Mountain View, CA 94943; 415-903-5200.*
Circle 955 on reader service card

NEW

Digital and Cisco Partner in Multiprotocol Router

Digital Equipment Corp.'s recent alliance with Cisco Systems has produced DECbrouter 90, a bridging router with multiprotocol interoperability. DECbrouter 90 offers extensive protocol support, including Integrated Intermediate System to Intermediate System (Integrated IS-IS), open shortest path first (OSPF), and Interior Gateway Routing Protocol (IGRP). IGRP support allows the DECbrouter 90 to interoperate with all Cisco and Cisco-based routers. The multifunctional bridge-router works as a standalone bridging router, or as a module within a DEChub intelligent hub. DECbrouter 90 is available in two versions: 802.3/Ethernet to a single T1/E1 port and 802.3/Ethernet to one T1/E1 port and one 64-kilobit-per-second port.

• List price: *DECbrouter 90T1 single serial-port standalone, $3,290; DECbrouter 90T1 single serial-port DEChub module, $3,240; DECbrouter 90T2 dual serial-port standalone version, $4,350; DECbrouter 90T2 dual serial-port DEChub module, $4,300. Digital Equipment Corp., 146 Main St., Maynard, MA 01754; 800-344-4825.*
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BRIEFS

ROUTERS

Chipcom Corp. has introduced a new module for its ONline family of intelligent switching hubs. The ONline Ethernet Interconnect Module can operate as a high-speed Ethernet switch, a high-performance bridge, or a multiprotocol bridge/router. The module ($5,995 to $10,495) is based on Intel's i960 RISC microprocessor and is designed as a cost-effective performance upgrade. 508-460-8900.

RAD Network Devices announced FD1, an advanced FDDI card for its line of Open Gate multiprotocol routers: the OG-C12 or OC-C4. FD1 ($8,125 to $12,000) supports all FDDI standards, including the Internet Protocol, DECnet, and IPX. The FD1 card is available as a dual-attached station or a single attached station for either an FDDI network or connection via an FDDI concentrator. 714-891-1446; fax, 714-891-1764.

HUBS

Chipcom Corp. and **IBM** plan to incorporate asynchronous transfer mode (ATM) technology into their respective lines of intelligent switching hubs. The two companies plan to introduce their high-speed backbone networking products early in 1994 and provide desktop ATM-based products later on in the year. Chipcom: 508-460-8900; fax, 508-460-8950. IBM: 800-426-3341.

DigiBoard Telecom Group's new PC IMAC/4 expansion ($1,195-$3,980) card turns a personal computer into an Integrated Services Digital Network (ISDN) communications hub. Up to five cards can be installed in an ISA bus personal computer for a total of 20 ISDN connections. 612-943-9020.

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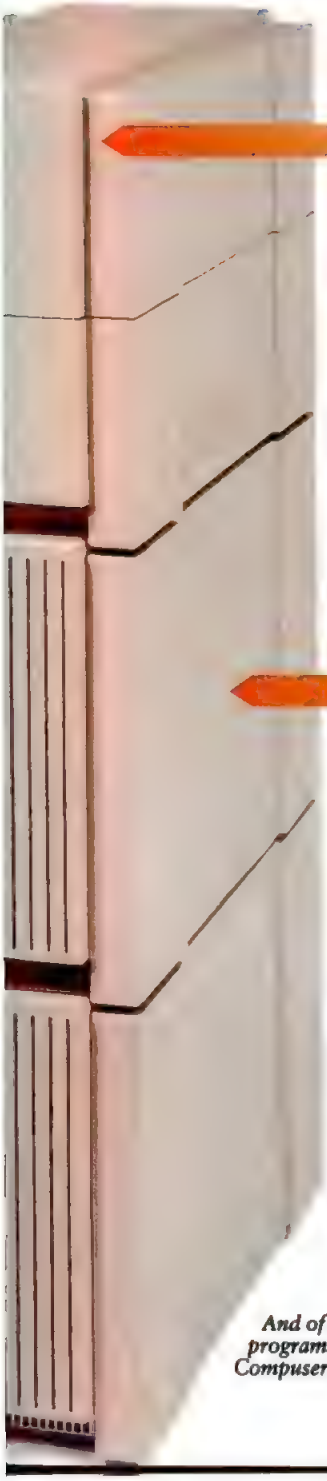
ISOLATION MODULE

Provides unmatched power protection and full VA capacity of multiple loads, even while in bypass.

Unlike older ferro-based designs, Matrix is compatible with servers which employ power-factor corrected power supplies. Standard 3-wire 208V input means no re-wiring

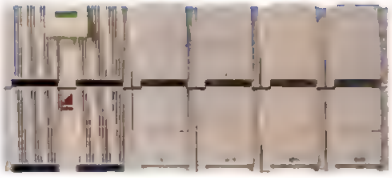
neers for a midrange UPS
0 % lower lifecycle costs,
to pieces...



SmartCells

Need more runtime? Add SmartCells™ in seconds with no need to take system down.

Microprocessor-controlled, self-diagnosing, zero-maintenance SmartCells end expensive service contracts.



For multiple servers...

Systems	Stnd * Matrix	Stnd Runtime
10 Compaq SystemPros	5000	10 minutes
10 RS/6000s w/ 19" mon.	5000	10
15 386/33s w/VGA	5000	10
4 Sun 4/490s	5000	11

For midrange systems...

Systems	Stnd Matrix	Stnd Runtime
2 DEC Vax 4000-500s	3000	12 minutes
3 HP 9000s	5000	11
IBM AS/400	3000	13
inc:9406 E45 proc., 9337 DASD, 7208 tape, 3477 dis.		

* Shown as standard configuration. For additional runtime, simply add more SmartCells.

Electronics Module

Matrix offers a control panel in four languages, plus programmable output voltages, automatic bypass and more. Best of all, even the electronics module is completely hot-swappable for maximum system uptime.

Line-interactive design with online inverter means high-reliability, low operating costs. The unit's surge protection is backed by APC's $25,000 ABSOLUTE Downstream Protection Policy which will repair/replace any equipment damaged by a surge while protected by Matrix (see details).

Matrix provides auto-shutdown support of all major network, and midrange OS. The SNMP-compatible Matrix also supports APC's Measure-UPS which meters temperature and humidity, and monitors smoke, fire, water, and security detectors.

MATRIX SERIES

- 3000 and 5000 VA protect up to 22 servers or 2 fully loaded midrange systems.
- Hot-swappable modules for 100% uptime, 60% lower lifecycle costs
- SNMP support and automatic server shutdown (for NetWare, UNIX, NT, OS/400, VAX, Sun and more) protects data, lowers LAN support costs
- Environmental and power monitoring provides "glass room" level security

FREE Matrix video!

Call Dpt. E4!

The Matrix heritage: more awards than all other UPS vendors combined...

And of course, Matrix is backed by a suite of award-winning support programs, including a two-year warranty, 24X7 toll-free tech support, a Compuserve forum, software upgrades, and more.

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CIRCLE 915 ON READER SERVICE CARD

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NEW

Synernetics Expands Client-Server Switching

Synernetics' plans for a new FDDI module will provide network managers with decreased per-port costs and increased performance. The new module, FCM-TP (FDDI Concentration Module-Twisted Pair), lets you run FDDI information over copper wires (Level 5 unshielded twisted-pair) using 12 ports. Built for the LANplex 5000 intelligent switching hub, the module offers Ethernet switching at 100 megabits per second (Mbps).

FCM-TP can be purchased with the LANplex hub for a per-port price of $700, or as a standalone unit. The module makes the LANplex 5000 competitive with FDDI concentrator hubs that offer concentration over copper wiring but not Ethernet switching. Synernetics will offer the new module in December.

• List price: *FCM-TP, $9,950. Synernetics, 85 Rangeway Rd., N. Billerica, MA 08162; 800-992-2446, 508-670-9009; fax, 508-670-9015.*

Circle 957 on reader service card

IMPROVED

UB's MasterLAN Gains On-board SNMP

Ungermann-Bass now offers more effective management of an Ethernet network that uses the company's MasterLAN ISA Network Adapter Card at no additional cost: The card now sports an on-board SNMP agent. SNMP on the desktop allows network managers to monitor and control every MasterLAN-equipped workstation in the network from NetDirector (Ungermann-Bass' network management platform) or from any other SNMP-compliant network management system. Another advantage is that placing the agent directly on the card saves valuable host memory. The SNMP agent also includes MIB II support and BootP support.

• List price: *SNMP Agent for MasterLAN, free as an upgrade to MasterLAN ISA adapters ($375). Ungermann-Bass, World Headquarters, 3900 Freedom Circle, Santa Clara, CA 95052-8030; 800-777-4526; fax, 408-970-7386.*

Circle 958 on reader service card

IMPROVED

Novell Extends SNMP Management Support

Novell addresses the need for enterprise-wide network management with the latest version of its software developer's kit. The NetWare Management System Software Developers Kit (NMS SDK), Version 2.0, features a set of SNMP-based tools and application programming interfaces for managing a NetWare environment, including hubs, servers, desktops, routers, services, and applications.

SERVERS AND ALL: NMS SDK manages the entire NetWare environment.

NMS SDK includes two new features: a NetWare server MIB and SNMP support that allows any SNMP console to manage NetWare servers and server-based applications, and an SNMP desktop transport that allows developers to build applications that relay information from the desktop system to any SNMP management system.

• List price: *NetWare Management System Software Developers Kit, Version 2.0, $495. Novell Inc., 122 East 1700 South, Provo, UT 84606-6194; 800-453-1267, 801-429-7000.*

Circle 959 on reader service card

BRIEFS

ADAPTERS

Network Peripherals and **SynOptics Communications** signed an agreement to develop adapters for ATM-based networks. The SBus ATM adapter will combine the Network Peripherals' adapter and software technology of Network Peripherals with SynOptics' ATM strategy. The adapter will support multimode fiber, shielded twisted-pair, and category 5 UTP. SBus ATM will available in January 1994. Network Peripherals: 408-321-7300; fax, 408-321-9218. SynOptics: 800-776-6895; 408-988-2400.

Codenoll Technology Corp. reduced prices on its FDDI and Fiber Optic Ethernet adapters. In order to make FDDI more cost-effective, the CodeNet-9540 FDDI PC/AT LAN adapter is now $995, down from $2,995. The CodeNet-9740 SDDI 100Mbps for PC/AT is $795, reduced from $1,995; and the CodeNet-8391 10Base-FL Transceiver is $295, down from $395. In addition, the CodeNet-835X NuBus Fiber Optic Ethernet Adapters have been reduced from $895 to $595. 914-965-6300; fax, 914-965-9811.

NDC Communications announced its new six-in-one Ethernet adapter. The ND6000-E ($199) is a software-configurable Ethernet Network Interface Unit that provides the functionality of six commonly used adapters from 3Com, Novell, and SMC/WD. The board offers plug-and-play compatibility with Novell's NE1000 and NE2000, the SMC/WD WD8003EBT and WD8013EBT, and the 3Com EtherLink II/16. The ND6000 does not ship with its own drivers; for ease of installation and administration, it supports the LAN drivers created by these other companies. 408-428-9108; fax, 408-428-9109.

Would You Buy A Print Server That's 100% Faster Than The Leader?

How About 200% Faster?

How About 300% Faster?

(Compared to Netport II in independent testing by LANQuest Labs, February, 1993)

Introducing the Novell NPE400.

Compare for yourself, then connect your printer to the network with the Novell print server that outperforms the leading units. Just look at the speed figures in the performance chart.

Competitive Comparison	Novell NPE400	Intel Netport II	Castelle LANPRESS 1+1
Data Transfer Rate	62.5K	26.2K	57.9K
10Base2 & 10Base-T on same unit	Yes	No	Yes
Automatic Font Downloading	Yes	No	No
Warranty, years	5	1	2
Printer Attachment	Direct	Cable	Cable

The NPE400 is ideal for:

- High-speed, NetWare network printing.
- Eliminating the need for dedicated PCs.
- Placing printers near users.
- Improving productivity.

Now check out the price difference: a rock-bottom $499 suggested list! What a concept: a faster Novell print server for less money! Plus, you get all these other features:

- Supports thin wire and twisted pair Ethernet on the same adapter.
- Co-developed with Novell: 100% compatible with NetWare v2.x, v3.x and NetWare 4.0.
- Easy to install using NetWare-style interface.
- No switches or jumpers—autosenses media type and frame formats.
- Low maintenance — initial set-up survives power outages.
- Compact form factor.

So call your local Novell/Eagle dealer and order today. And for your FREE copy of the LANQuest test results and NPE400 technical specifications, call **1-800-52-4EAGL.**

EAGLE TECHNOLOGY

Manufacturers' suggested list prices and specifications for Novell NPE400, Intel Netport II, and Castelle LANPRESS 1+1 are as of 6/1/93. Eagle Technology, 2865 Zanker Road, San Jose, CA 95134
NetWare is a registered trademark of Novell.
All other trademarks are of their respective holders. All prices are in U.S. dollars.

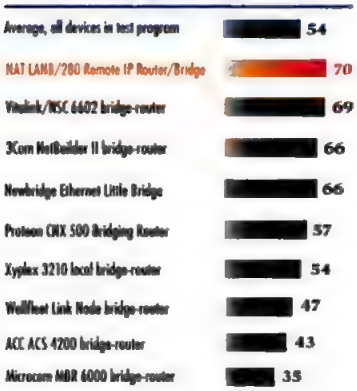
CIRCLE 860 ON READER SERVICE CARD

NAT's Remote IP Router Makes Routing Bunches of Information Easier.

Rapi Nui men of Easter Island race with heavy loads, commemorating deadly clan rivalries of past times.

If your data is competing fiercely for position on the phone line, you're likely to lose a bunch of packets before the race is over. So before you risk your most important data across the WAN, you'd better consult with Network Application Technology.

COMMUNICATIONSWEEK BRIDGE/ROUTER RATING



NAT's LANB/290 Remote IP Router/Bridge is the latest revision to NAT's already acclaimed LANB/280 Remote IP Router/Bridge.

NAT's LANB/290 Remote IP Router provides the most affordable high-performance solution for expanding Internet Protocol networks to remote locations. The LANB/290 passes data between networks more efficiently by routing only necessary traffic over the WAN link.

The LANB/290 routes information easily, even in today's multi-vendor enterprise networks. It is compatible with Ethernet routers from other vendors—forwarding non-IP packets using the standards-based Point-to-Point Protocol (PPP).

The NAT router supports the latest SNMP standard, so it's compatible with the most advanced management stations (including NAT's own NMS/100). So, you can maximize the potential of your multi-vendor network.

Great features are meaningless if you can't get the router up and running—that's why NAT designed the LANB/290 to be a true plug-and-play device—so installation and operation won't drive you bananas!

Don't let your network traffic become a spectacle. Beat the competition and pick an NAT router.

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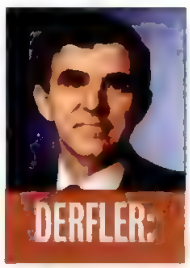
CIRCLE 864 ON READER SERVICE CARD

SMS: The Future of LAN Backup?

David, recommending Novell's Storage Management System (SMS) is like trying to paint a moving train. The standard isn't standing still. Today's hot SMS-compliant product is probably tomorrow's orphan product in need of a brain transplant so it can talk to the next bunch of hot SMS-compliant products.

And, despite the hype, the supposed SMS "standard" is just a Big Red service inside NetWare. Portability of data to other operating system environments is at the whim of Novell. NetWare lays the data on the tape or disk in a special format, and software called Target Service Agent (TSA) must run on the receiving operating system to decode it. The TSA cupboard is bare.



Already, SMS software shipped with NetWare 3.11 and the software shipped with NetWare 4.0 don't sing from the same sheet music. Yes, Novell has patches and new releases on NetWire, but the software doesn't stand still long enough to adopt it.

Today's hot SMS-compliant product is tomorrow's orphan product in need of a brain transplant.

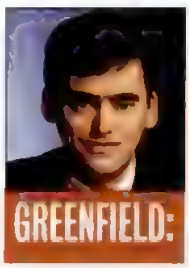
Interoperability and compatibility? Swapping tapes between devices from different manufacturers? Dream on, Dave! Interoperability won't happen without direct cooperation between the vendors of storage devices. Compliance with a standard doesn't mean interoperability between products. Show me a vendor committee actively exchanging tapes and working toward interoperability and I'd feel a lot more comfortable pointing our readers toward SMS. But when that happens, vendors will lose the uniqueness of their products and have to sell on price. Tape vendors will back this approach with the same enthusiasm Republicans bring to tax increases.

In the meantime, Microsoft is shipping an open backup standard and API called the Microsoft Tape Format (MTF) in Windows NT. The MTF is part of the Win32 development set, so you can expect to see it in all products, including new releases of Windows that conform to Win32. The MTF-compliant products use a format that is optimized for tape, unlike the SMS format that tries to be all things to all devices. The MTF format marks every block of data with a logical unit identifier that makes it much easier to move data between operating systems without the need for special decoding programs like the TSAs.

SMS is an elegant architecture for NetWare. But moving data between NetWare and other operating systems requires more than elegance. It calls for a lot of grunt-level interaction.

Frank, you ignorant slug! I can't understand why you want to junk Novell's Storage Management Services (SMS). It may not be perfect, but it's the best backup architecture available from any of the major networking vendors.

SMS provides four critically needed features for today's backup market: a logical recording format, file migration APIs, multiclient support, and a standard interface between the backup system and the file server.



Most network backup systems remain the proprietary domain of their respective vendors. Data written by one backup system typically cannot be read by another backup system. Network managers are either locked into a single vendor or must undergo a painful migration when moving to another LAN backup system. A logical recording format lets any compatible backup system read and write to the same storage media.

Novell's Storage Management Services (SMS) may not be perfect, but it's the best backup architecture available.

File-migration APIs will allow storage backup systems to move less frequently used files to less frequently used media. These APIs let users make the most of the various storage media: optical drives, DAT drives, and the like. And by creating a clean interface between the clients and the backup systems, administrators can easily backup a wide range of file systems.

Finally, SMS features a standard network backup interface that makes LAN backup more manageable by ensuring that, although changes may be made to the network operating system, those changes won't require enhancements to the network backup system.

Over the long term, SMS needs to be integrated into Novell's enterprise management features. This will enable users to instantly and transparently locate a file anywhere on the network and on any medium.

Frank, even without these additional features, SMS is far ahead of what's offered by Microsoft or Banyan. Neither company has a vision of LAN backup that is as clear or as extensive Novell's.

I will grant you that there is one problem that has plagued SMS since the specification was announced: delivery. Many components of Novell's specification are still not available. But in spite of this, SMS remains an important step in the right direction.

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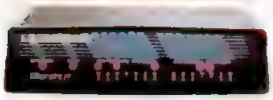

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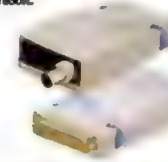

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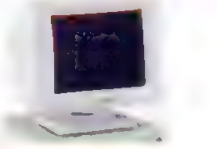

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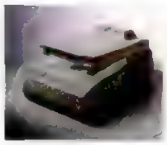

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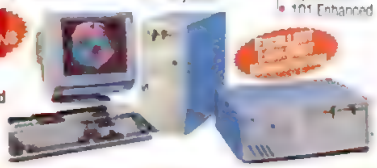

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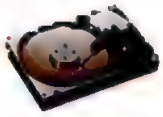

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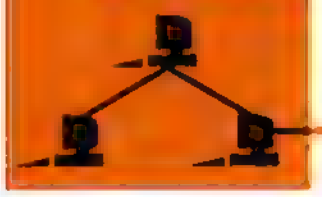

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851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867	868	869	870	871	872	873	874	875
876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900
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926	927	928	929	930	931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949	950
951	952	953	954	955	956	957	958	959	960	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975
976	977	978	979	980	981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	

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The Final Word on Printer Echo

Improved Path Editing

BY NEIL J. RUBENKING

THE FINAL WORD ON PRINTER ECHO

In the September 15, 1992, issue of *PC Magazine*, you asked for information about the printer echo flag. DOS versions 3.3, 4.01, and 5.0 all have their printer echo flag 23h bytes before the inDOS flag, whose address can be obtained with DOS function 34h. The printer echo flag is either 0 (inactive) or 0FFh (active). Figure 1 lists a DEBUG script that creates SPE.COM, CPE.COM, and PE.COM (Set Printer Echo, Clear Printer Echo, and Printer Echo). (You can download all these files from PC MagNet's Utilities/Tips Forum. The files are archived as PRNECH.ZIP.)

Bent Lynggaard
Solrad Strand, Denmark

▶PC MAGAZINE: Pressing Ctrl-PrtSc or Ctrl-P *toggles* the printer echo flag, that is, it turns it on if it's off and vice versa. When this flag is turned on, every line written to the screen via DOS Standard Output is also printed on the printer. The September 15, 1992, User-to-User column demonstrated a technique to toggle printer echo under batch file control, but no way to specifically set it on or off. Then in the June 29, 1993, issue, a reader came up with DOS 3.1-specific utilities to turn printer echo on and off. I modified the programs to work with DOS 5.0, but the result was still not entirely satisfactory. This time we've finally homed in on a truly general solution to the problem of getting the current value of the printer echo flag and explicitly setting or clearing the flag. The tiny utility programs presented with this article appear to work with *all* DOS versions from 3.1 on, including DOS 6.0.

To create the three utilities, redirect the script PRNECHO.SCR shown in Figure 1 into DEBUG with the following command:

```
DEBUG < PRNECHO.SCR > PRNECHO.LOG
```

You'll want to check the PRNECHO .LOG file for the string ^ Error; if this string appears, the line above contains an error. Correct it and try again. Now test the programs. Enter PE and the program will probably respond with "Printer echo is off." Enter SPE and then type DIR; the directory will appear on the screen *and* the printer. Enter CPE to turn off printer echo. You're sure to find uses for these little programs in your batch files.

IMPROVED PATH EDITING

PATHEDIT.BAT, published in the September 29, 1992, User-to-User column, makes it easy to add and remove path directories. Unfortunately, PATHEDIT is flawed: Because of DOS's command line limit, the batch file does not work if your path is too long. In this situation the FOR loop gets truncated, producing various errors depending on just where the line gets clipped.

Can PATHEDIT.BAT be improved to get around this limitation?

Peter Seifert
Vienna, Austria

PRNECHO.SCR

Complete Listing

```
A 100
MOV  AH,34
INT  21
ES:
MOV  BYTE PTR [BX-23],FF
MOV  DX,0115
MOV  AH,09
INT  21
MOV  AX,4C00
INT  21
DB   0D 0A 'Printer echo is active$'

N SPE.COM
R CX
32
W

E 108 00
E 12B 'inactive$'
N CPE.COM
R CX
34
W

A 104
ES:
MOV  AL,[BX-23]
MOV  DX,0123
CMP  AL,00
JZ   0119
MOV  DX,0139
CMP  AL,FF
JZ   0119
MOV  DX,014E
PUSH AX
MOV  AH,09
INT  21
POP  AX
MOV  AH,4C
INT  21
DB   0D 0A 'Printer echo is off$'
DB   0D 0A 'Printer echo is on$'
DB   0D 0A 'Unknown flag$'

N PE.COM
R CX
5D
W
Q
```

Figure 1: This DEBUG script creates programs to turn printer echo on and off or report its current state.

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▶PC MAGAZINE: Thanks for pointing out the difficulty with the original PATHEDIT.BAT. The problem, of course, is that DOS does limit a command line—whether typed at the DOS prompt or contained in a batch file—to 127 characters. In batch files, this limit applies *after* all replaceable parameters, environment variables, and FOR variables have been replaced by their values. Thus a batch line that looks short may expand to be larger than the 127-character limit.

The DOS Path is actually limited to 122 characters: 127 minus the five characters PATH=. Two particular lines in the original PATHEDIT.BAT create problems when the path is close to that limit. The line `SET tmp_path=%path%` is intended to save the value of the path, for later restoration. But this line truncates the path at 114 characters!

Worse still is the FOR loop that processes each directory on the path:

```
FOR %%a IN (%PATH%) DO CALL %0
sub %%a
```

Replacing %PATH% with 122 characters and %0 with the eight-character string PATHEDIT yields a line that is 160 characters long. And that doesn't even count the further expansion that takes place when the two occurrences of %%a are replaced by a directory from the path. If the longest directory in the path is 15 characters, any path longer than 65 characters will cause this line to fail!

Solving the problem with the SET tmp_path line was easy—I just replaced the environment variable name tmp_path with a one-letter name. I chose the character ¼ for the one-letter name, since it's not likely to be used by other batch files. There's still a tiny limitation: The longest path that the modified line can handle is 121 characters, not 122.

To solve the second problem, I had to get rid of the FOR loop entirely. I renamed the batch file PE.BAT, and used a one-character string to invoke a subroutine within the batch file, rather than using the string *sub*. Instead of using a FOR loop to process each directory on the path individually, I passed the *entire* path with the line `%0 ¼ %PATH%`. The batch file's name replaces the %0, and DOS treats the individual path entries as separate command line parameters, making it easy for PE.BAT to process them one by one.

Figure 2 shows the streamlined batch file PE.BAT. (You can download it from the User-to-User section of PC MagNet's Utilities/Tips Forum.) You call it with two parameters, an operation code, and a directory name. The operation code can be +, &, or –. Respectively, these add a new directory at the end of the path, add a new directory at the start of the path, or delete the specified directory from the path. A fourth operation code, ¼, is used internally by PE.BAT when it reexecutes itself to drop a file from the path. PE.BAT still won't work with a path that's precisely 122 character long, but it's a lot more friendly to long path names than the original PATHEDIT.BAT. □

PE.BAT

Complete Listing

```
@ECHO OFF
:PE.BAT - Path Editor.  Add or remove directories
IF '%2'=='' GOTO Help
IF '%1'=='+' GOTO AddEnd
IF '%1'=='&' GOTO AddBegin
IF '%1'=='-' GOTO Drop
IF '%1'=='¼' GOTO DoDrop
GOTO Help

:===== AddEnd ========
PATH=%PATH%;%2
ECHO %2 added at end of path.
GOTO End

:===== AddBegin ======
PATH=%2;%PATH%
ECHO %2 added at beginning of path.
GOTO End

:===== Drop ==========
SET ¼=%PATH%
PATH=%2
SET PE_drop=%path%
:: Now variable drop contains %2 capitalized
PATH=%¼%
SET ¼=
SET PE_rem=
:: Restart, passing PATH as parameters
%0 ¼ %PATH%

:===== DoDrop ========
SET PATH=
:==  DropLoop
SHIFT
IF '%1'==='' GOTO DoneDrop
IF '%1'=='%PE_drop%' GOTO DidRemove
IF '%PATH%'==='' PATH=%1
IF '%PATH%'==='%1' GOTO DropLoop
PATH=%PATH%;%1
GOTO DropLoop
:==  DidRemove
SET PE_rem=YES
GOTO DropLoop

:===== DoneDrop ======
IF '%PE_rem%'==='' ECHO %PE_drop% not found
IF '%PE_rem%'=='YES' ECHO %PE_drop% removed from path
SET PE_drop=
SET PE_rem=
GOTO End

:===== Help ==========
ECHO The options are:
ECHO %0 + directory   :  adds directory at end of path
ECHO %0 & directory   :  adds directory at start of path
ECHO %0 - directory   :  drops directory from path
ECHO Note that the PATH must not be empty.

:===== End ===========
PATH
```

Figure 2: **This batch file easily adds and removes directories on the path, including long paths.**

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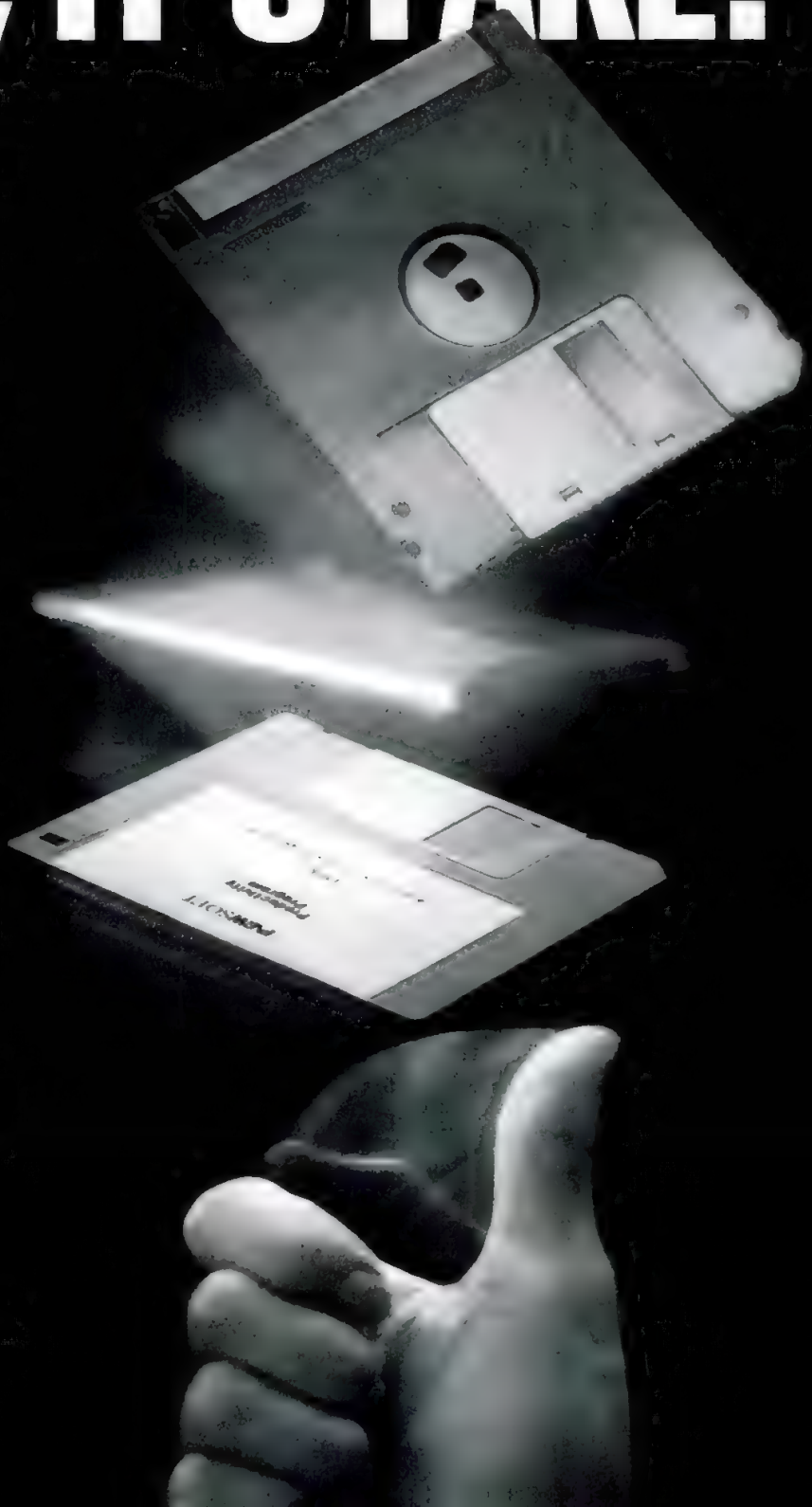

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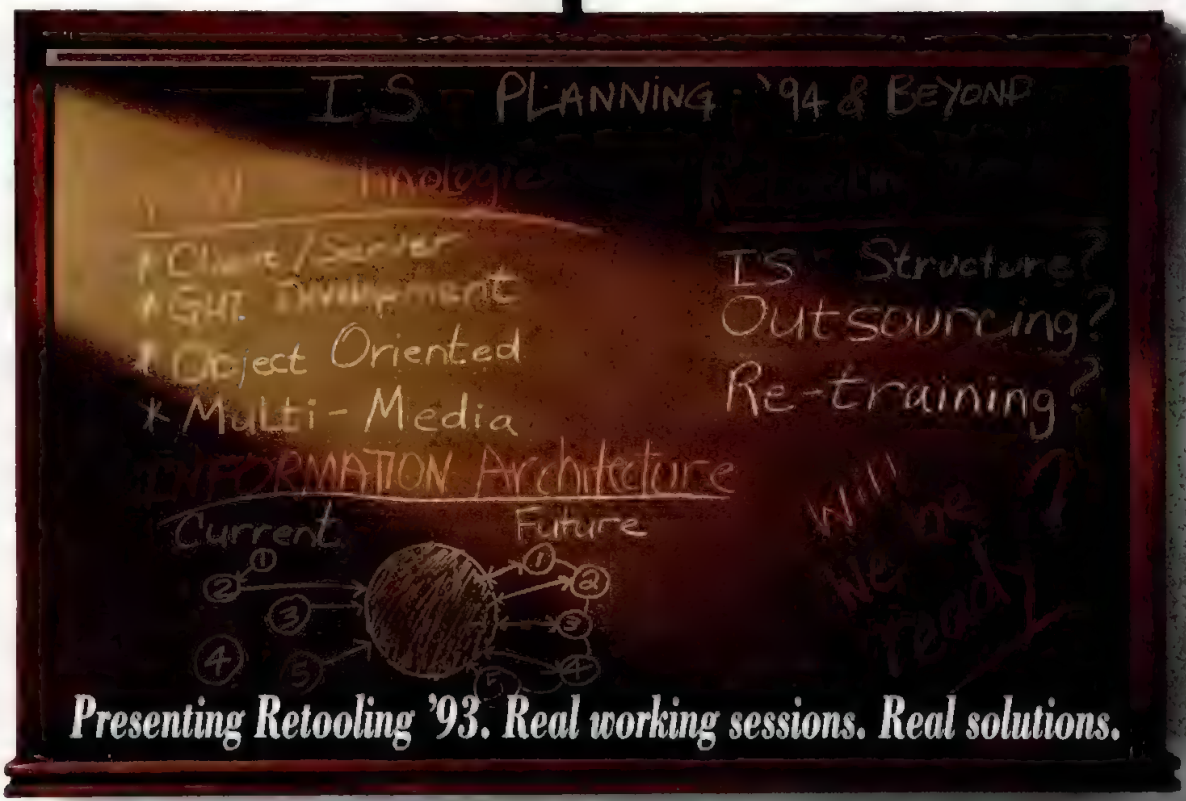

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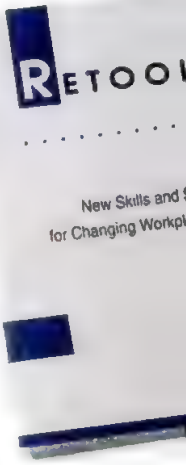

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Writing DOS Utilities With DEBUG, Part 1

BY JEFF PROSISE

In an age when a program written in C or another high-level language is considered small at 40K, there's something appealing about a functioning program that weighs in at 100 bytes.

In the next few installments of Tutor, you'll learn how to use DEBUG to create small assembly language utilities of your own. You don't have to be an expert assembly language programmer to write DEBUG utilities. In fact you can get away with knowing only a dozen or so assembly language instructions. I'm going to assume that you know little or nothing about assembly language and don't particularly care to become a programmer, but that you would like to build small utility programs to solve specific problems. As you do this, another advantage will come your way: You'll gain valuable insights into how computers and software work.

DEBUG isn't only for debugging programs. It contains a built-in mini-assembler that compiles assembly language instructions into machine code. This is an essential part of any debugger, because it allows programs to be modified. Rather than modify existing programs, however, we'll use this feature of DEBUG to generate new programs from scratch. Not many users own a full-blown assembler such as the Microsoft Macro Assembler, but everyone who has a copy of DOS has DEBUG.

In this issue we'll build a small program named GETKEY, which reads a character from the keyboard and returns an exit code identifying the key that was pressed. The aim of this exercise is twofold: First, it will provide an unintimidating first look at assembly language. Second, it will introduce two of the many programming services available in DOS and in the BIOS that assembly language programs can call upon to perform rudimentary tasks—in this case, reading the keyboard and outputting characters to a batch file. In subsequent columns, you'll learn about other assembly language commands and learn more about the full range of programming services that DOS and the BIOS provide.

PLANNING THE UTILITY The first step in building the GETKEY utility is to decide how we're going to read a character from the keyboard. In assembly language, there are two easy ways to do it.

You don't have to be an expert to create assembly language utilities. With DEBUG and a little knowledge of the language, you can easily write small but useful programs.

One method is to call upon DOS function 08h, Character Input Without Echo. If the keyboard buffer is currently empty, function 08h waits until a key is pressed and then returns the key's ASCII code in register AL.

A *register* is a storage location inside your PC's microprocessor. The 8086 contains several internal storage registers—AX, BX, CX, DX, SI, DI, CS, DS, ES, SS, SP, BP, IP, and FLAGS—each capable of storing 16 bits of information. AX, BX, CX, and DX are general-purpose registers used for general-purpose data storage. The 8-bit halves of the AX, BX, CX, and DX registers may be addressed as AH, AL, BH, BL, and so on. AH references the upper 8 bits of AX (bits 8–15), while AL references the lower 8 bits (bits 0–7). The H in AH stands for *high,* while the L in AL stands for *low.* SI and DI, commonly referred to as the *index registers,* are used for general-purpose storage and for string operations involving multibyte data sequences. CS, DS, ES, and SS are *segment registers.* On the 80*x*86 family of microprocessors running in real mode, you identify a precise location in memory by specifying a 16-bit segment address and a 16-bit offset address. The corresponding 20-bit physical memory address is calculated by multipying the segment address by 16 (10 hex) and adding the offset. Thus, the segment:offset address 40:17 resolves to 400h + 17h, or 417h (in the hexadecimal system, you can multiply a number by 16 by adding a zero to the end). Twenty address bits permit the microprocessor to read and write up to 1MB of RAM. Segment registers are used differently in protected mode to allow the CPU to access more than 1MB of memory. SP and BP are *pointer registers* used to address data stored on the stack (an area of memory used for temporary data storage). IP stands for *instruction pointer.* CS:IP holds the address of the next machine code instruction that the CPU will execute. Finally, the FLAGS register holds several bit-size flags that are referenced by other assembly language instructions. You'll learn more about the FLAGS register in coming months.

The second way to read a character involves calling interrupt 16h, function 00h, a programming function in your PC's ROM BIOS that returns an ASCII key code in register AL. An *interrupt* is a mechanism for transferring program execution from one location to another, not unlike a CALL or GOTO command in BASIC. On the PC, interrupts are a convenient means for calling subroutines

ROM BIOS Interrupt 16h Keyboard Functions

Function number:	00h
Function name:	Read Character From Keyboard
Description:	Returns the ASCII code of the next key waiting to be read from the keyboard buffer in register AL. If the keyboard buffer is empty, function 00h waits until a key is pressed. For keys that have no corresponding ASCII code (for example, the function keys and cursor keys), function 00h returns a 00h in AL and an extended key code in AH. A value of 00h in AL and 3Bh in AH, for example, identifies function key F1.
Call with:	AH = 00h
Returns:	AL = ASCII code of the key that was pressed; if AL = 00h, AH contains the code that identifies the key. If AL contains an ASCII key code, then AH holds the key's scan code—an integer that uniquely identifies every key on the keyboard.
Function number:	01h
Function name:	Get Keyboard Status
Description:	Informs the calling program if any key codes are waiting to be read from the keyboard buffer.
Call with:	AH = 01h
Returns:	If the keyboard buffer is empty: Zero flag = 1. If the keyboard buffer is not empty: Zero flag = 0 and AH and AL are set to the values that function 00h will return in AH and AL the next time it is called.
Notes:	The state of the microprocessor's zero flag can be tested with the assembly language JZ (Jump on Zero) and JNZ (Jump on Not Zero) instructions. In addition, the key that's waiting is *not* removed from the buffer by this function.
Function number:	02h
Function name:	Get Keyboard Flags
Description:	Returns a series of bit values in register AL that identifies the state of the Shift, Ctrl, and Alt keys, as well as the current state of NumLock, CapsLock, ScrollLock, and Ins.
Call with:	AH = 02h
Returns:	AL = Shift status, encoded as follows:
	Bit 0: 1 = Right Shift key is pressd; Bit 1: 1 = Left Shift key is pressed; Bit 2: 1 = Ctrl key is pressed; Bit 3: 1 = Alt key is pressed; Bit 4: 1 = ScrollLock is on; Bit 5: 1 = NumLock is on; Bit 6: 1 = CapsLock is on; Bit 7: 1 = Ins is on.
Notes:	Individual bit values are tested with the assembly language TEST instruction.

Figure 1: **Interrupt 16h, function 00h is only part of a larger family of keyboard services provided by your PC's ROM BIOS. Here are the three interrupt 16h keyboard services that are available on every PC.**

stored in DOS and in the BIOS. Most DOS functions are accessed using interrupt 21h. BIOS keyboard functions use interrupt 16h. Interrupt 16h, function 00h has an added benefit: If you press a key that has no corresponding ASCII code (for example, a function key or cursor key), it returns 00h in AL and an extended ASCII code in AH that uniquely identifies the key. (Processing an extended ASCII code with DOS function 08h requires you to call the function twice.) Calling either of these programming functions is analagous to calling a subroutine in BASIC or another high-level language. The difference is that you're invoking a subroutine stored in DOS or the BIOS rather than inside your own program.

Altogether, DOS and the BIOS support hundreds of different programming functions, all designed to make the job of writing programs easier. You'll learn more about these functions as we go along. In most cases, a function is invoked by using the MOV command to place the function number in the AH register and executing an INT command with the appropriate interrupt number (very often, other registers must be filled in as well). For example, the instructions

```
MOV AH,00
INT 16
```

copy ("MOV") the value 00h into register AH and use interrupt 16h to invoke function 00h in the keyboard BIOS. MOV is probably the most common assembly language instruction. It copies data from the operand to the right of the comma to the one on the left. MOV AX,BX, for example, means "copy the value in BX to AX." MOV AH,00 means move 0 into register AH. The instruction

```
INT 16
```

generates an interrupt 16h, which in turn invokes the interrupt 16h handler in the ROM BIOS. In response to an INT 16 instruction, the CPU fetches the segment: offset address of the routine that processes calls to interrupt 16h from a table of addresses (interrupt vectors) at the base of conventional memory, and then transfers control to that address. When the interrupt handler is done, it executes an IRET (Interrupt RETurn) instruction to return control to the program that called it, and the program resumes executing at the instruction following the INT 16 instruction. In this context, then, the INT instruction is simply a vehicle for programs to call external system subroutines without knowing the physical addresses at which they lie. After these two instructions execute, the AL register holds an ASCII code.

DEBUG always thinks in hexadecimal. You shouldn't type an h after 00 and 16; DEBUG knows you're entering hexadecimal numbers and in fact *expects* you to enter hexadecimal numbers. Hexadecimal (*hex*, for short) is a base 16 numbering system. Compare this with decimal, which is a base 10 numbering system. The hex digits 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, and F correspond to 0 through 15 decimal. In hex numbering, the value of each "place" increases by a factor of 16 as you read from right to left. The hex number A50h, for example, reduces to $(10*16^2)+(5*16^1)*(0*16^0)$ or (10 * 256) + (5 * 16) + (0*1), or 2,640 decimal.

Interrupt 16h, function 00h is only one of several interrupt 16h functions built into your PC's ROM BIOS. Figure 1 lists the three interrupt 16h keyboard services that are available on every PC (many PCs support several more interrupt 16h functions, but these three are common to all

IBM PCs and compatibles). Don't worry too much about the details of using these functions just yet. The important thing at this point is to realize that interrupt 16h, function 00h is part of a larger family of keyboard services provided by your PC's ROM BIOS. Other BIOS interrupts provide interfaces to other hardware devices. Interrupt 10h, for example, is the gateway to an assortment of useful video services, while interrupt 17h provides a software interface to printers.

The next step in laying the plans for a GETKEY utility is formulating a method for terminating the program and returning an exit code that can be tested with an IF ERRORLEVEL command in a batch file. DOS function 4Ch, named Terminate Process With A Return Code, is the vehicle for doing just that. Function 4Ch takes a function code (4Ch) in AH and an exit code in AL. Like nearly all DOS functions, it is accessed through interrupt 21h. The instructions

```
MOV AH,4C
MOV AL,80
INT 21
```

terminate the currently running program and return an exit code equal to 80h (128 decimal). Since AH and AL are both part of the AX register, these instructions can be shortened to

```
MOV AX,4C80
INT 21
```

BUILDING THE GETKEY UTILITY We now have in hand the two pieces of information that we need to build the GETKEY utility: a method for reading the keyboard, and a method for terminating the program and returning an exit code. All that remains now is to enter the instructions with DEBUG and store them to disk as a .COM program.

The first step is to start DEBUG. To do this, go to the directory where you want GETKEY.COM to be stored and type

```
DEBUG
```

at the DOS prompt (make sure DEBUG is stored in a PATH directory, or you'll have to specify the full pathname batch file, as in C:\DOS\DEBUG). Next, at DEBUG's hyphen prompt, type

```
A 100
MOV AH,00
INT 16
MOV AH,4C
INT 21
```

The A command starts DEBUG's built-in assembler and begins a display of segment:offset addresses. The number after A tells DEBUG what starting address to use when it stores the bytes of machine code. The normal starting address for .COM files is 100, so almost every set of DEBUG instructions will begin with A 100. The next four lines are the assembly language instructions. It is not necessary to load AL with a value before terminating the program with DOS function 4Ch, because AL already holds the ASCII code returned by interrupt 16h, function 00h.

Now press the Enter key to end the assembly phase and return DEBUG to command mode (you'll see the hyphen prompt redisplayed). Then type

```
N GETKEY.COM
RCX
8
W
Q
```

The command N GETKEY.COM names the program. RCX displays the value of the CX register, and 8 sets it to 8. The value of CX determines the number of bytes that the next command, W (for Write), will write to disk. The program is 8 bytes long. The final command—Q for Quit—quits DEBUG and returns to the DOS prompt. If you type DIR, GETKEY.COM should now be listed among the files.

ASCII Key Codes

Code	Key	Code	Key	Code	Key
65	A	97	a	48	0
66	B	98	b	49	1
67	C	99	c	50	2
68	D	100	d	51	3
69	E	101	e	52	4
70	F	102	f	53	5
71	G	103	g	54	6
72	H	104	h	55	7
73	I	105	i	56	8
74	J	106	j	57	9
75	K	107	k		
76	L	108	l	9	Tab
77	M	109	m	13	Enter
78	N	110	n	32	Space
79	O	111	o	27	Esc
80	P	112	p		
81	Q	113	q		
82	R	114	r		
83	S	115	s		
84	T	116	t		
85	U	117	u		
86	V	118	v		
87	W	119	w		
88	X	120	x		
89	Y	121	y		
90	Z	122	z		

Figure 3: **These ASCII codes are returned in AL by GETKEY.COM.**

YESNO.BAT

Complete Listing

```
@ECHO OFF
ECHO Do you want to run CHKDSK (Y/N)?
:ASK
GETKEY
IF ERRORLEVEL 78 IF NOT ERRORLEVEL 79 GOTO END
IF ERRORLEVEL 110 IF NOT ERRORLEVEL 111 GOTO END
IF ERRORLEVEL 89 IF NOT ERORLEVEL 90 GOTO CHECK_DISK
IF ERRORLEVEL 121 IF NOT ERRORLEVEL 122 GOTO CHECK_DISK
GOTO ASK
:CHECK_DISK
CHKDSK
:END
```

Figure 2: **This batch file uses the GETKEY.COM assembly utility to get user response from the keyboard. If the user types Y or y, CHKDSK will run; if he or she types N or n, the batch file will end.**

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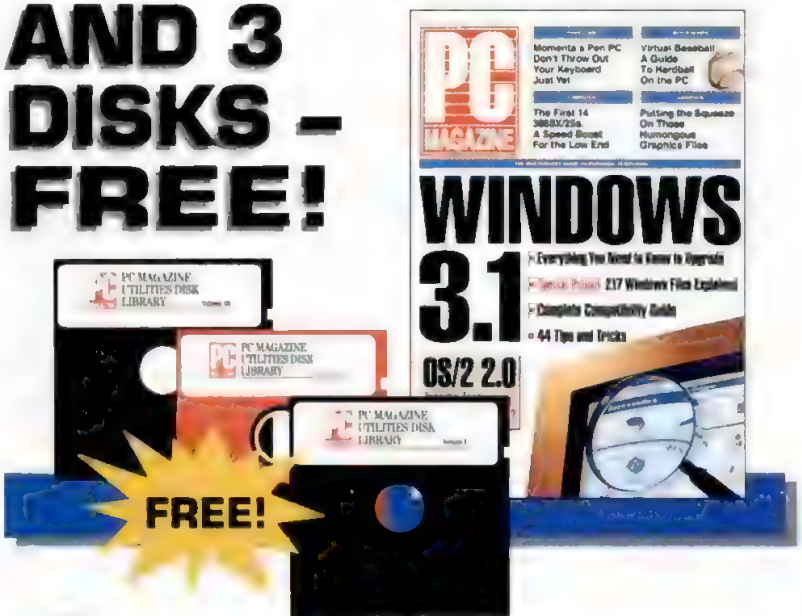

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How do you know the program was 8 bytes long? Simple: After the last assembly language instruction was entered, but before Enter was pressed to return DEBUG to command mode, DEBUG displayed an 8-digit segment:offset address that ended with the numbers 0108. Subtract 0100 from this (in hex) and you get 8, which corresponds to the number of bytes in the program you just entered. You can always compute the length of a program entered in DEBUG by subtracting 0100 from the final offset address that DEBUG displays.

USING GETKEY With GETKEY.COM now in hand, create the batch file in Figure 2 using EDIT or the text editor of your choice. Call the batch file YESNO.BAT.

YESNO.BAT calls GETKEY to read a keystroke. If you press N (whose ASCII code is 78) or n (ASCII code 110), YESNO.BAT branches to the line labeled END, bypassing the command that invokes CHKDSK. If you press Y (ASCII code 89) or y (ASCII code 121), YESNO.BAT branches to the line labeled CHECK_DISK, which is immediately followed by the CHKDSK command. If you press any other key, none of the four IF ERRORLEVEL tests branches and execution falls through to the command GOTO ASK, which loops back to the GETKEY command. With this routine, it's easy to build batch files that ask the user for a yes or no response. (Note: The command IF ERRORLEVEL *x* IF NOT ERRORLEVEL *x+1* is a quick way to test for an exit code of a specific value; the conventional form of the command, IF ERRORLEVEL *x*, tests for a *range* of values, returning true if the exit code is equal to *x* or higher.)

Figure 3 contains a partial list of the ASCII codes that GETKEY returns. GETKEY returns 0 for keys that generate extended codes, so it cannot be used to trap keys for which no unique ASCII code exists.

STILL TO COME In the next Tutor column, we'll expand on this discussion by presenting additional programming functions and constructing utilities around them. Specifically, we'll survey some of the useful programming functions that DOS provides, such as getting the DOS version and the date and time. □

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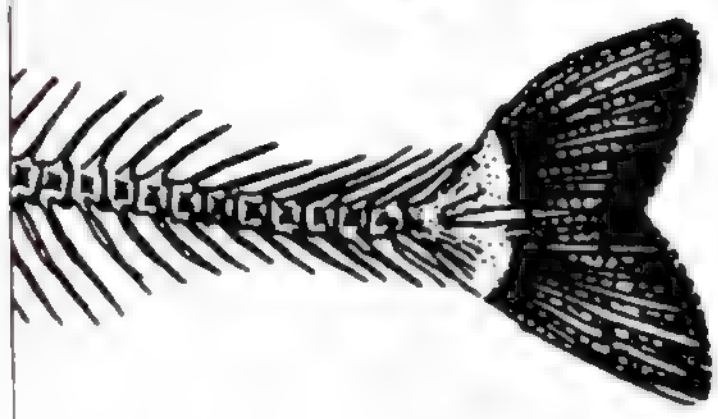

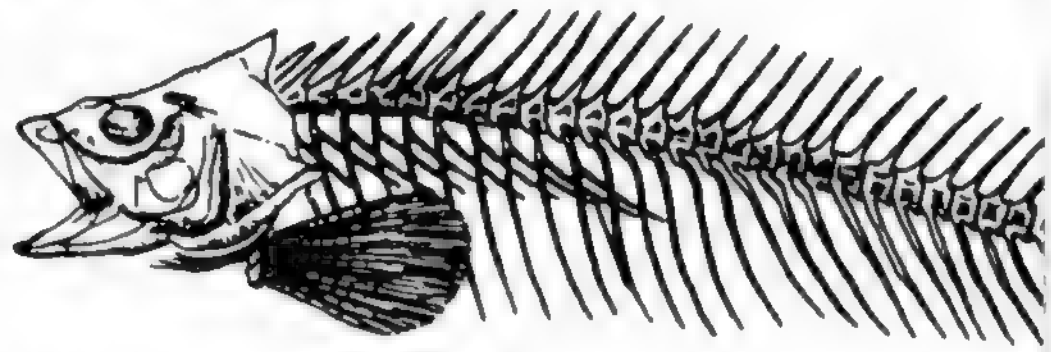

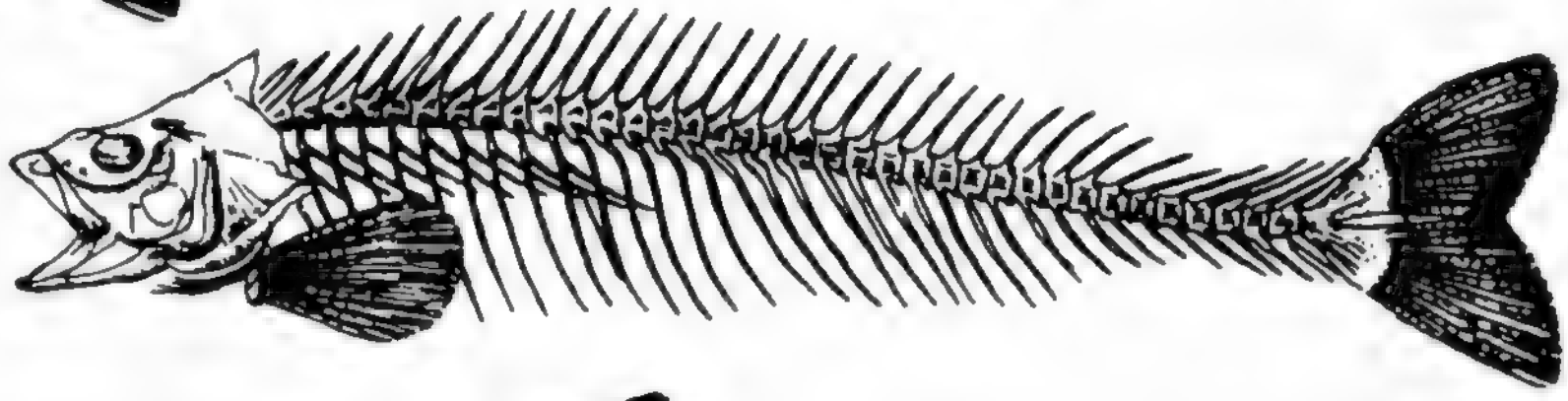

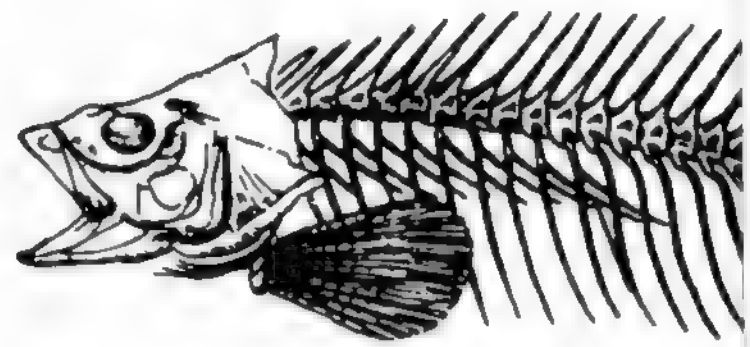

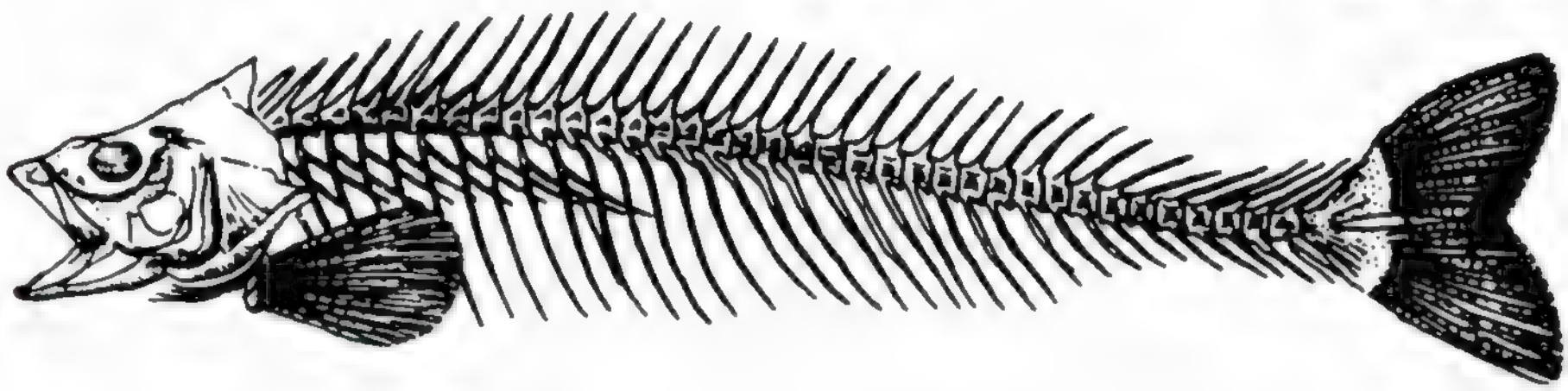

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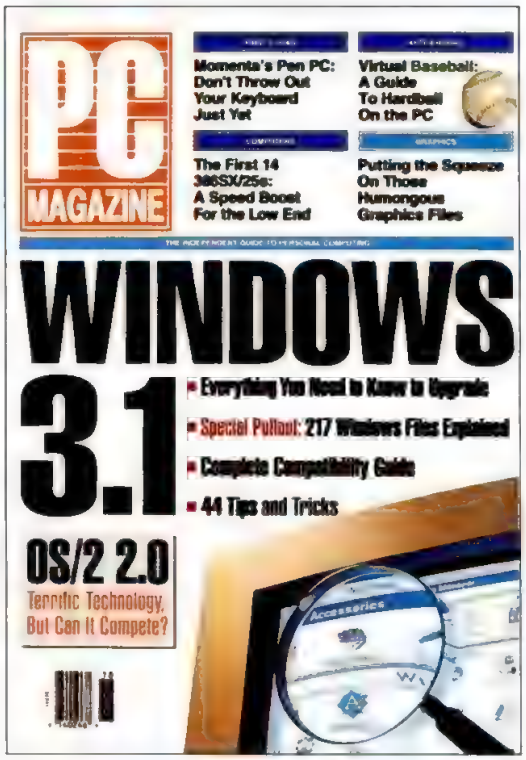

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Tuning DOS and WIN-OS/2 Sessions Under OS/2 2.*x*

BY JOE SALEMI

OS/2 2.0 brought two new capabilities to IBM's top-of-the-line PC operating system: the ability to run multiple DOS sessions, and built-in Windows 3.0 emulation. With OS/2 2.1, there is support for Windows 3.1 as well. These new capabilities make OS/2 a viable alternative to plain DOS or Windows, as users can easily continue to use most of their existing software. New OS/2 users don't have to throw out every application they have and buy OS/2 versions.

However, these new features come at a cost—increased complexity in getting the best performance out of the operating system. I covered one aspect of tuning the operating system earlier this year ("Demystifying CONFIG.SYS in OS/2 2.0," *PC Magazine*, February 23 and March 16, 1993). In this article I cover the set of parameters in OS/2 2.*x* that control the behavior of each DOS and WIN-OS/2 session. These parameters can have a significant impact on both the overall system performance and on how well each application runs.

In addition to controlling each DOS session's UMB capabilities (capabilities similar to those introduced in MS-DOS 5.0), the additional parameters determine how much low, EMS, and XMS RAM (real and virtual) each DOS and WIN-OS/2 session can access. They also determine how the system shares the COM ports, and whether a DOS or WIN-OS/2 session can access some of the hardware ports directly. In all, OS/2 2.0 provides no less than 48 DOS session settings; OS/2 2.1 adds one more DOS setting and three WIN-OS/2 settings to the OS/2 2.0 list.

Fortunately most DOS and Windows programs will run properly with the default settings. But as you get more comfortable with the operating system, you'll find yourself wanting to tweak its performance to match both your own working style and your system's capabilities. About half of the 49 different settings can significantly affect overall system performance or that of individual DOS or Windows programs. This Lab Notes will concentrate on these important settings, provide explanations of what they do, and give recommendations on how best to set them for your particular needs.

Although the default parameter settings will generally work, you can sometimes pay a heavy performance penalty. Here's how to adjust the settings for your specific needs.

GETTING THERE Nearly every object on the desktop of the OS/2 2.*x* WorkPlace Shell (WPS) has a system menu. Depending on the object, you can access this menu in one of two ways. If the object is an icon, you simply put the mouse pointer on it and click the right mouse button. If the object is a folder or a program running in a WPS window, you place the pointer on the system menu icon in the upper-left corner of the window and then you click the right mouse button.

The first option on the system menu is labeled "Open." To the right side of "Open" is a button labeled with a right-pointing arrow, as shown in Figure 1. Clicking on the arrow button brings up a submenu of the objects you can open. The first item on the list is usually labeled "Settings." Clicking on this once with the left mouse button opens the Settings window.

The Settings window looks like a spiral notebook with divider tabs along its right-hand side. The screen you want is labeled "Session," and you can reach it by clicking on the Session tab. If the object associated with the icon is a DOS or Windows program, the Session screen will have a number of options, as shown in Figure 2.

The first option you should set is where the program is to run. OS/2 grays out the settings that don't apply, so the windowed WIN-OS2 choices are inactive for DOS and OS/2 programs, and only the WIN-OS/2 choices are active for Windows programs. As you can see in Figure 2, you can choose to run a DOS program in a window on the desktop or in its own full-screen session. You can also elect to run a full-screen WIN-OS/2 session from within a DOS session, just as you can in regular DOS. Although it's a matter of personal preference, if the DOS program is graphics-intensive you'll generally get better performance by running it full-screen. Regardless of your choice here, however, you can always switch the program from full-screen to windowed and back by pressing the ALT-Home key combination.

The WIN-OS/2 settings are a bit different. You still can choose between running the Windows program full-screen or on the desktop, but you can't change the mode with ALT-Home once it's running. An additional option governs whether a Windows program running on the WPS desktop runs as part of a common WIN-OS/2 session or starts its own session. Windows programs in a common session inherit the settings of the first Windows

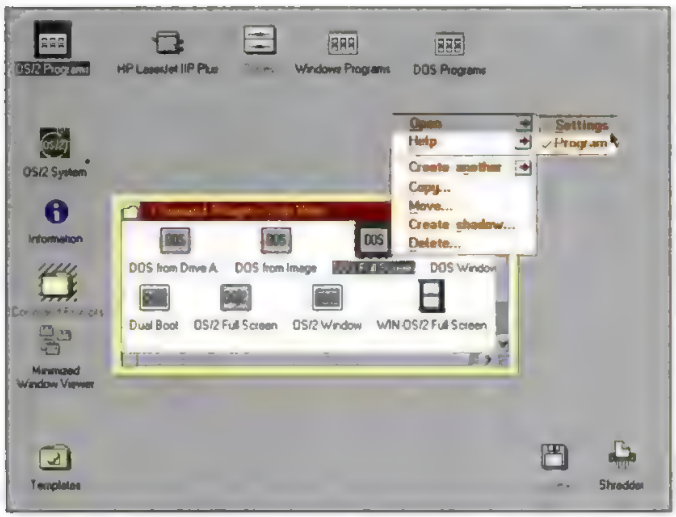

***Figure 1:* The Settings options are reached by clicking on the arrow button in the Open box of the system menu.**

program you launch. If you want to customize the settings for a specific Windows program, you click on the button labeled "Separate Session." The program will then be controlled by its own settings, not by those of any other currently active Windows programs. Full-screen Windows programs always run in the same common session; this option is only available for programs run on the desktop.

An advantage of running Windows programs in their own sessions is that each session is protected by OS/2's memory protection mechanisms. Thus, if one session locks up or crashes, the other WIN-OS/2 sessions won't be affected. But there are disadvantages as well. OS/2 has to load the Windows support code for each WIN-OS/2 session, slowing down the program's loading speed. Also, the additional code takes up more RAM; you won't be able to run as many programs simultaneously before OS/2 must start swapping to disk, and disk swapping incurs a performance hit. You should therefore use the Separate Sessions option cautiously, reserving it for programs that absolutely must use different settings, or for mission-critical programs that need OS/2's memory protection.

Your next step is to click on the large button located in the center of the notebook screen. It will be labeled either "DOS Settings" or "WIN-OS/2 Settings," as appropriate. This selection will bring up the Settings list, where you can view and change the individual configuration parameters for that session. The Settings list provides accompanying text descriptions of each parameter, as shown in Figure 3. Note that clicking on the Default button will return all the settings to the defaults OS/2 established when it was installed.

THE PARAMETERS

The 49 parameters in the DOS Settings window are the same for both DOS and WIN-OS/2 sessions, so the discussion that follows applies to both program types. The 3 parameters applicable only to WIN-OS/2 sessions will be covered at the end of this Lab Notes.

You can change each parameter by clicking on it with the mouse pointer to highlight it. OS/2 then displays the available values for that setting in the upper-right corner of the window. Depending on the parameter you have selected, you will make your changes by using radio buttons, moving a slider bar, or choosing items (or filling in your own) from a parameter list. If the brief explanation provided in the description box is insufficient, you can get more information from the Master Help Index (accessible from the Help button) or from the parameter's icon in the Information folder that's on the desktop.

The settings that have the most effect on the system's performance are presented below in the order in which they appear in the list. The comments apply equally to DOS and WIN-OS/2 sessions unless it is otherwise noted. Most of the parameters can be set on the fly and will take effect immediately, even if the program is active. Those that must be set from the icon before the program can be run will be noted.

- `COMM_DIRECT_ACCESS`: This parameter controls whether a DOS program can access the COM port directly instead of going through OS/2's virtual driver. Most DOS communications programs run without problems when this parameter is set to OFF. However, if your communications program loses characters, or if you encounter numerous errors when transferring a file, try changing the setting to ON. Note that this parameter must be set before you run the communications program.
- `COM_HOLD`: Turning this ON gives the DOS session exclusive access to the COM port. OS/2 checks to see whether a COM port is busy before letting another program have access to it, and with the normal OFF setting, OS/2 regains control as soon as the program using the COM port releases it. This is usually fine if you're running a single program. You may, however, have a specialized communications program, such as a BBS, that chains to other programs. If the COM_HOLD setting is OFF, OS/2 will regain control of the port as soon as the first program terminates, that is, before the second one executes. Setting the parameter value to ON keeps the DOS session in control of the port so that the second program can continue where the first left off.

***Figure 2:* The Session screen shows the available options for a DOS or Windows program. Inapplicable options are grayed out.**

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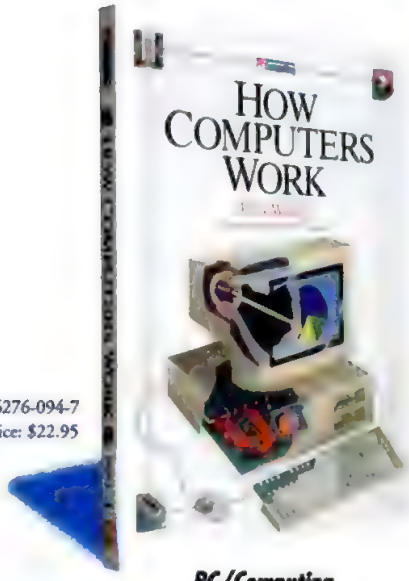

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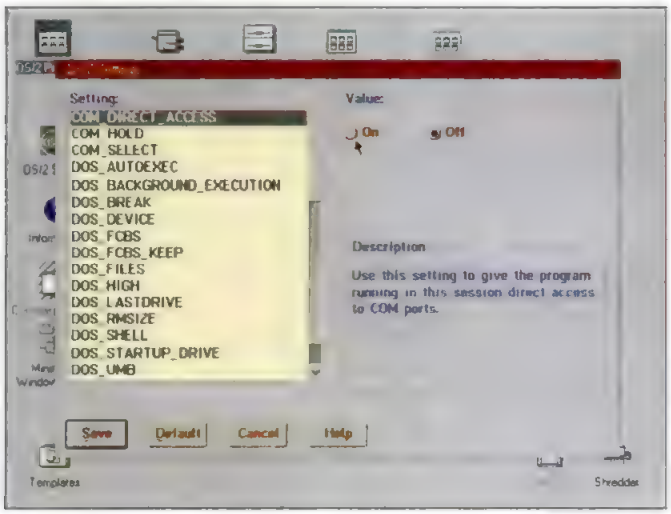

***Figure 3:* Bringing up the Settings list lets you change a session's individual configuration parameters.**

• DOS_AUTOEXEC: Under OS/2 2.0, every DOS and WIN-OS/2 session shared the same AUTOEXEC.BAT file, so you had to put all your options, TSRs, and SET commands in that file. Version 2.1 introduces a new parameter that lets you set the name of the startup file for an individual session. Thus, if you want to use a startup batch file that contains specialized commands for the program in this session, enter it here.

• DOS_BACKGROUND_EXECUTION: This parameter, which can have a significant impact on system performance, determines whether or not the program in a session can run in the background. OS/2 polls each active application to see whether it requires any system resources or attention. Many programs, such as word processors and games, just sit idle when they are in the background. By setting this parameter to OFF, you're instructing OS/2 to ignore this particular application when it's not in the foreground. This allows OS/2 to devote more of the system's resources to the active applications. Note, however, that you should always set this parameter to ON for WIN-OS/2 sessions that are running on the desktop or that are using the Windows-to-OS/2 DDE capabilities.

• DOS_DEVICE: If you want to make a DOS device driver available to all your DOS sessions, you can automatically load it by adding a

```
DEVICE=driver path/name
```

to the OS/2 CONFIG.SYS. However, there may be times when a device driver is needed only by one application. The DOS_DEVICE parameter lets you specify a device driver exclusively for this session. To do this, just type the driver path and name into the values window *without* the DEVICE= portion. OS/2 will then load the device driver only when you start the session. This is another parameter that must be set before the program is started.

• DOS_FILES: This parameter is the equivalent of the DOS FILES= CONFIG .SYS command. The default is 20 open files for each DOS session and 48 for each WIN-OS/2 session. You can increase this value to 255 at any time. It's best, however, to use the default unless you get errors related to insufficient file handles or unless the program's documentation suggests a particular value.

• DOS_HIGH: Like DOS 5.0 and 6.0, OS/2 supports loading the DOS kernel into the HMA. DOS_HIGH is the equivalent of DOS=HIGH in the DOS CONFIG.SYS. You can set this parameter globally in the OS/2 CONFIG.SYS (the default is to load DOS low) and then toggle it off for programs that don't need the full 640K DOS RAM. That will save some of the system's real RAM for other applications. DOS_HIGH should always be ON for WIN-OS/2 sessions.

• DOS_RMSIZE2: This parameter sets the amount of low RAM available to a DOS session. The default is 640K, and this should be left unchanged for WIN-OS/2 sessions. However, many DOS programs (particularly utilities) run in less memory, so you can lower this value for those programs. By leaving more real RAM available for other applications when possible, you'll reduce the amount of swapping the system has to do.

• DOS_UMB: This parameter is equivalent to the DOS=UMB command in an MS-DOS CONFIG.SYS. It can also be set globally in the OS/2 CONFIG.SYS; the syntax is the same. Setting it here lets you toggle the use of upper memory blocks on and off for each DOS session. You can set the parameter OFF if you're not loading TSRs into the UMB or if the application doesn't use this memory area. This will save some RAM for other applications.

• DPMI_DOS_API: Some applications use the DOS Protected Mode Interface (DPMI) specification to access extended memory. (The 3.*x* versions of Lotus 1-2-3 and most Windows programs are typical examples.) This parameter controls the way in which OS/2 gives such programs access to the API.

You should use the AUTO setting (the default) for programs that control DPMI themselves. Such programs usually use one of the DOS extender libraries. The ENABLED setting tells the operating system to control DPMI access, which is what Windows programs expect. DISABLED prevents an application from accessing DPMI. Thus, leave the DPMI_DOS_API parameter set to ENABLED for Windows programs, AUTO for DOS programs that you're not sure use DPMI, and DISABLED for programs you're sure don't use it at all. Although you can leave DPMI_DOS_API set to AUTO for most DOS sessions, disabling it when possible can increase a particular application's performance by slightly reducing the operating system overhead.

• DPMI_MEMORY_LIMIT: This parameter sets the amount of DPMI memory a program can access. Values are in 1MB increments and may range from 0 to 512MB. Set it to 0 if you have DPMI_DOS_API set to DISABLED. The default is 4MB, which is sufficient for most applications. Setting it higher than 4MB lets you run more Windows applications in a common session. Note that this setting must be established before you start the application.

• EMS_MEMORY_LIMIT: You can control how much EMS memory an application can access with this parameter. The default is 2,048K, which should be enough for most applications. You can set it to 0 to disable it for applications that

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don't use EMS, or to the minimum value recommended in the program's documentation. OS/2 does not allocate the memory until a program asks for it, so setting EMS_MEMORY_LIMIT to 0 will reduce system overhead by telling the operating system not to bother checking for EMS memory requests.

• HW_ROM_TO_RAM: This parameter is the OS/2 equivalent of the "shadow RAM" provided by some BIOS chip sets or DOS memory managers. Turning it ON tells OS/2 to copy the relevant ROM BIOS code to the faster RAM, which usually increases the performance of applications that rely heavily on that code. It doesn't hurt, and it usually helps to turn this setting ON.

• HW_TIMER: Turning this setting ON allows an application to have direct access to the 8253 timer port; otherwise, OS/2 emulates the hardware timer. The emulation timer is less precise than the hardware timer, and this may cause problems with some communications programs. The default is OFF, but you should use ON for comm apps.

• IDLE_SECONDS: Most DOS programs spend much of their time polling the keyboard, waiting for user input. OS/2 is able to prevent an idle program from wasting CPU time by keeping track of how often the keyboard is polled without anything else being done. Unfortunately, however, it's sometimes hard for OS/2 to distinguish between an application that is taking keystrokes from the keyboard buffer and one that is just polling the keyboard.

The IDLE_SECONDS parameter therefore lets you tell OS/2 how many seconds to wait before it starts monitoring keyboard activity. The default setting of 0 starts the monitor immediately, which is fine for most programs. However, some DOS programs have their own unique ways of handling keyboard input (XyWrite is a prime example), and this may fool OS/2 into thinking the programs are idle when they're not. In such a case, OS/2 lowers the application's priority even though the application is active, causing it to slow down while you're still typing. If you encounter unexpected slowdowns while typing, simply raise this value until the speed feels normal.

• IDLE_SENSITIVITY: This parameter controls OS/2's idle monitoring by setting the percentage of keyboard polling to look for before assuming the application is idle and lowering its priority. A setting of 100 tells OS/2 to turn the idle detection off. The default setting of 75 is sufficient for most applications. Again, however, if you find an application—particularly a word processor—slowing down while you are typing, set this parameter value to 100.

• PRINT_TIMEOUT: Many DOS programs do not send the proper command to tell the operating system that a print job is done. This usually causes no problems for a standalone machine running DOS, since the job is set directly to the printer by the application. When there's a print spooler involved, however—as on a network or under OS/2—the spooler doesn't know the application is finished printing, so it doesn't send the job to the printer until you close the application.

OS/2 can prevent an idle program from wasting CPU time by keeping track of how often the keyboard is polled.

The PRINT_TIMEOUT parameter sets the amount of time the OS/2 spooler waits before sending the job to the printer if it doesn't receive the Close command. The default setting of 15 seconds is sufficient for most applications. You should increase this value, however, if you find that the output from an application is being printed before the application finishes formatting the print job. (This is a common problem with complex graphics programs, such as a CAD-CAM application.)

• VIDEO_FASTPASTE: If you use OS/2's clipboard capabilities to transfer text from one DOS program to another, you can try turning this parameter ON. That will speed up the transfer from the clipboard to the application. Note, however, that VIDEO_FASTPASTE doesn't work with programs that handle keyboard interrupts directly. Moreover, it may also overflow the internal keyboard buffer of some programs. Since you can set the parameter value on the fly, however, it's worth experimenting with.

• VIDEO_MODE_RESTRICTION: This parameter works in the same way as those DOS memory managers that let you remap the UMB area used by the video board so that this area is added to normal DOS low memory. The parameter has two settings: CGA and MONO. The CGA setting adds another 96K on top of the 640K already available to the DOS session, giving you a total of 736K of low memory. MONO adds 64K, yielding a low memory total of 704K. For this parameter to work, however, you must set DOS_RMSIZE to 640K, and you can run only programs that you're sure use neither better-than-CGA graphics nor MONO text mode. If you change this setting and run an EGA- or VGA-mode program, the program might end up writing to the video area and corrupt its own data. This parameter should be left to NONE for WIN-OS/2 sessions.

• VIDEO_ONDEMAND_MEMORY: Different video modes require different amounts of RAM to run. An 80-by-25 text screen, for example, usually takes only about 4K of video RAM, but a VGA graphics screen can use as much as 256K video RAM. When you're running a DOS program in a full-screen session, OS/2 anticipates that you'll probably switch away from it and so preallocates the maximum amount of real or virtual RAM that will be needed to store the video image.

The VIDEO_ONDEMAND_MEMORY parameter tells OS/2 not to allocate the RAM until you actually switch away from the program. This has the positive effects of making the program load faster and of giving OS/2 better control over system resources. If your system is low on virtual RAM (swap space) however, the DOS image could become corrupted if OS/2 doesn't have enough space to save the image. Thus if you're tight on swap space, you should set this parameter value OFF for full-screen DOS sessions so that OS/2 can ensure there's enough video RAM available before running the program. If you've got sufficient space, however, or if you happen to be running three or fewer full-screen DOS sessions, you can simply leave the parameter set

to its default ON position.

The slight performance hit caused by having OS/2 allocate the memory when you switch away from the program is usually less that the slowdown caused by preallocating the memory when the program loads, since in the former case OS/2 knows exactly how much RAM to use instead of having to guess. Note that this parameter has no effect on windowed DOS or WIN-OS/2 sessions.

• VIDEO_RETRACE_EMULATION: When this parameter value is set ON, OS/2 controls how often a DOS program's screen is redrawn; when it's OFF, the program itself has control over the video retrace. ON is the default, but some DOS programs (particularly those that use CGA graphics) may run slower with that setting.

Turning VIDEO_RETRACE_EMULATION to OFF speeds up the program, but may have the unpleasant side effect of corrupting the screen display if you switch away from the program and then switch back. The reason is that the program's video refresh gets out of sync with OS/2. Since VIDEO_RETRACE_EMULATION is a dynamic parameter, you can experiment with it to determine which setting works best for a particular program. You'll want to note, however, that you should leave it set to ON for WIN-OS/2 sessions.

• VIDEO_ROM_EMULATION: This dynamic parameter affects only DOS session text modes. When set ON (the default), OS/2 emulates the video BIOS functions that control how fast text is written to the screen. This is usually faster than the board's ROM. Thus you should leave this parameter value set ON unless you have a high-end video board that provides its own enhancements to these text output functions. Since you can change this parameter value on the fly, you can test your programs both ways to see if there's a significant difference between the two settings. It has no effect on WIN-OS/2 sessions.

• VIDEO_WINDOW_REFRESH: This parameter affects only windowed DOS sessions. It controls how often, in tenths of a second, OS/2 redraws the session's screen. The default is to redraw the screen every tenth of a second. If you increase this value (up to once a minute), overall system performance will increase because OS/2 spends less time redrawing the screen and more time on other tasks. However, if you set the value too high, the output in the windowed session may become jerky. This is a dynamic parameter, so you can experiment with it while the application is running and so determine the best balance between system performance and screen redrawing. A good way to see the effects of this command is to do a DIR or TYPE a long text file in the windowed session with different settings.

• XMS_HANDLES: The advent of DOS memory managers brought about the Extended Memory Specification (XMS), which gives DOS programs a standard way of accessing extended memory. The XMS_HANDLES setting controls the number of XMS handles available for a DOS session to use. The default of 32 is more than sufficient for the majority of applications; setting it any higher can slow down the whole system. Although each handle takes up a bit of RAM, you normally shouldn't change the XMS_HANDLES parameter even if your application doesn't use XMS, for DOS itself may be using the handles to manage the UMB or HMA area. However, if you have DOS_HIGH and DOS_UMB set to OFF for a particular session, you can lower this setting to 0 to speed up the program's loading time. Note that you must set this parameter value before loading the program.

• XMS_MEMORY_LIMIT: This parameter controls how much XMS memory, in kilobytes, is available to a program. The default is 2,048K; the maximum is 16MB. OS/2 preallocates this memory, so if you're sure your program doesn't use XMS memory, you can set this parameter value to 0 and speed up both program load time and overall system performance. Note that the setting must be made before the program is loaded.

WIN-OS/2 SETTINGS There are three additional settings, new in OS/2 2.1, that are available only to WIN-OS/2 sessions. OS/2 2.1 also provides global settings for WIN-OS/2 sessions; these are available from an icon in the System Setup folder. Here are the three new parameters.

• WIN_RUN_MODE: This setting determines whether the WIN-OS/2 session runs in Windows 3.1 Standard mode (the default), or in Windows 3.1 Enhanced mode. Most Windows programs can run in Standard mode, so you can leave this set to the default. That's advantageous because Standard mode uses less memory and system resources than Enhanced mode. The Enhanced mode is provided for the few currently available programs that require it; for example, a 32-bit application or a Windows 3.1-specific application. A program should tell you if it needs Enhanced mode when you try to load it, but it may just fail to load at all. If you encounter this problem, try turning WIN_RUN_MODE ON. You should also set such a program to run in its own session so that you don't have to have the additional overhead of Enhanced mode in every WIN-OS/2 session.

• WIN_DDE: This setting controls whether Dynamic Data Exchange (DDE) is available between WIN-OS/2 sessions and OS/2 applications. If you don't plan on creating DDE links between Windows and OS/2 or between Windows applications running in different WIN-OS/2 sessions, you can turn this OFF, which will save some system overhead and speed the loading of Windows applications. Note that this parameter setting has no effect on DDE between Windows applications running within the same Windows session.

• WIN_CLIPBOARD: The last setting controls whether the Windows Clipboard is to be public—available to the whole system—or private to WIN-OS/2 sessions. If you turn it ON, you can use the Clipboard to move Windows text to DOS or OS/2 sessions. If you turn it to OFF, you can share the Clipboard only with other Windows applications running in the same session. If you do not intend to use the Clipboard to move objects around between sessions, turning the setting to OFF will significantly cut down on system overhead.

The remaining parameters mostly affect how the system interacts with the hardware and have little or no effect on system performance. As with anything in the PC world, however, experimenting with the settings may help you find the best mix for your specific needs. □

JOE SALEMI IS A CONTRIBUTING EDITOR TO *PC MAGAZINE*.

Locate Available IRQs With FINDIRQ

BY RICK KNOBLAUGH

When you purchase a scanner or other peripheral device, the installation instructions usually tell you to set the jumpers on the board for an "available IRQ." Even if you know what an IRQ is, however, chances are you don't know which ones are in use and which are still free. If you install your new device to use an already-assigned IRQ, it may well cause a system crash.

What you need is FINDIRQ, *PC Magazine*'s free utility that tells you which devices in your system are using which IRQs and which IRQs are unassigned.

An IRQ is simply a hardware interrupt request line that allows a peripheral to signal the computer's central processing unit that an event requiring the CPU's attention has occurred. AT-style machines have 16 IRQ lines; older PCs have but 8. A few IRQ assignments are more or less standard on AT-type machines: The timer uses IRQ0 and the keyboard uses IRQ1, for example. But if you've added optional peripherals, such as a scanner, mouse, or fax modem, you need a program like FINDIRQ to learn which IRQs the peripherals have appropriated.

Users of Windows 3.1 and/or DOS 6.0 may wonder whether the new Microsoft Diagnostics (MSD) program makes FINDIRQ unnecessary. MSD does a good job of showing IRQ assignments for standard devices, such as COM and LPT ports. However, MSD will not report the IRQ assigned to any device that is not on its internal list. MSD will tell you the name of the program controlling a given IRQ only if you have not disabled STACKS in your CONFIG.SYS file (more on this later).

Further, since it lacks FINDIRQ's TSR option, MSD overlooks IRQs that are enabled only while a device—such as a sound board—is active. FINDIRQ's TSR option also allows it to detect IRQ usage for devices that are only activated under Windows. If you have a Microsoft InPort mouse, for example, and you use it only under Windows (and no DOS driver for it is installed), most DOS-based diagnostic programs will never detect that the device is present. And while there are a number of commercial IRQ-detecting programs, each with its strengths and limitations, FINDIRQ can hold its own against any of them.

Let FINDIRQ take the guesswork out of setting the IRQ jumpers when you install a new peripheral into your computer.

To download a copy of FINDIRQ from PC MagNet, just follow the instructions in the sidebar "PC MagNet: Utilities and More." To get the executable portion of the program, download FINDIR.COM from the Utilities/Tips Forum. An additional file, FINDIR.ZIP, contains the complete assembly language source code and the required include files. To work from the source files, you will need the Microsoft MASM assembler (or compatible), and the LINK and EXE2BIN utilities.

If you don't have a modem, you can get both the executable and source files by sending a postcard with your name, address, and preferred disk size to the attention of Katherine West, Utilities, *PC Magazine*, One Park Ave., New York, NY 10016-5802. No phone calls please.

USING FINDIRQ If you keep FINDIRQ.COM in a subdirectory on your path, simply entering `FINDIRQ` from a DOS prompt will bring up a display similar to that shown in Figure 1. The IRQ usage of all standard devices (those of which the BIOS has knowledge: COM*n* and LPT*n*) will be shown, along with that of any optional devices (like sound boards or SCSI adapters) that are currently enabled. IRQ assignments for devices controlled by TSR programs will also be displayed if the TSR is loaded in conventional memory.

To report IRQ information for devices controlled by TSRs that are loaded in high memory, FINDIRQ must be invoked with LOADHIGH, thus `LH FINDIRQ`. Note that when FINDIRQ is loaded high, it can still detect TSRs loaded into low memory, so if you use high memory on your system, it's always a good idea to load FINDIRQ high.

In listing the IRQ usage, FINDIRQ assumes certain standard device IRQ assignments. For example, if the BIOS re-

Top 10 Utilities

Rank	Utility
1	**DIRMATCH** - *Compares directories*
2	**BAT2EXEC** - *Compiles batch files*
3	**BUGS** - *Windows 3.1 screen saver*
4	**CHKFRAG** - *Checks fragmentation*
5	**INCTRL** - *Installation control*
6	**PCSPOOL** - *Print spooler*
7	**CLIPST** - *Extends the clipboard*
8	**DEFRAGER** - *Defragments disks*
9	**WINCMD** - *Command file interpreter*
10	**CHANGER** - *Varies Windows' look*

This list is based on the total number of downloads each utility has had on PC MagNet over the past 12 months. To download these files, type GO ZNT:TIPS. For more information, see the sidebar "PCMagNet: Utilities and More."

Figure 1: **FINDIRQ indicates which of your system's IRQs are being used and which are unassigned.**

ports that two COM ports are present, it assumes that COM1 uses IRQ4 and COM2 uses IRQ3; these are the standard AT assignments. If your system supports steerable IRQs and you have routed them to nonstandard assignments (a rare situation), FINDIRQ will not properly report the IRQs used by those devices.

For standard devices, FINDIRQ displays the device name. For optional character devices, FINDIRQ displays the name of the device as specified by the device driver. For optional block devices, "Block Device" is displayed. If a device is being handled by a TSR, FINDIRQ displays the name of the TSR program.

FINDIRQ SYNTAX OPTIONS To document even unusual and elusive interrupts, FINDIRQ provides a variety of optional parameters. In summary form, the syntax for the command is

```
[LH] FINDIRQ [/t] [/i] [/u]
 [/d] [/h]
```

As indicated initially, some interrupts are enabled only when the devices that use them are active. To detect such devices—sound boards, for instance—FINDIRQ must be memory-resident at the time the devices are activated. FINDIRQ can be installed as a TSR, therefore, by entering `FINDIRQ /t`.

When the TSR component of FINDIRQ is loaded, your system is constantly being monitored in the background for IRQ activity. When a previously unassigned IRQ is enabled, its IRQ information is stored in a tiny, 2-byte data file, FINDIRQ.DAT, which FINDIRQ creates in its subdirectory. FINDIRQ uses the information in this file to supplement what it knows about IRQ usage. This scheme can't tell you whether a temporarily activated IRQ is currently in use, but it can tell you that the IRQ has been used at some point and is probably not available for other devices.

If you change your system configuration—by removing or rejumpering a board, for example—you must reinitialize the FINDIRQ.DAT file. This is done by executing the /i option `FINDIRQ /i`. Regardless of whether the TSR component is resident, you display IRQ usage in the same way—by typing FINDIRQ with no switches. If the resident portion is currently loaded, a notation will appear on the left side of the display. Although the resident portion of FINDIRQ is very small (less than 3K), you can unload it if you wish by typing `FINDIRQ /u`.

In certain cases, programs can erroneously enable IRQs; that is, the IRQs can appear to be in use when in fact they are not. To guard against false reporting, FINDIRQ normally verifies that enabled IRQs have valid handlers before reporting that they are unavailable. This is done by checking that the handler is not simply a ROM default interrupt handler, whose job is to field spuriously generated interrupts.

When an IRQ is enabled under Windows and no DOS device driver for the device is installed, however, the handler cannot be verified. There are also other instances in which interrupt handlers cannot be verified, such as when IRQ enabling is intermittent or when a memory manager has remapped ROM. In these circumstances, FINDIRQ will incorrectly report that the IRQ is available. To suppress FINDIRQ's verification requirement and so avoid this problem, you can execute FINDIRQ with its "don't verify" switch: `FINDIRQ /d`. Finally, to remind yourself of the range of FIND-

▪ The Take Command of Windows Contest

PC Magazine and ZiffNet challenge you to take command of your Windows environment and win a Sony Discman. WINCMD is a *PC Magazine* utility that lets you create simple Windows batch programs. Write a script that automates a Windows operation and enter it in the Take Command of Windows Contest.

The script that's most original and useful will win. The winner will receive a Sony Discman portable CD player plus a Gift Bag containing a *PC Magazine* black satin racing jacket and various ZiffNet goodies. Three runners-up will also be chosen and will each receive a Gift Bag. All entries will be judged by Contributing Editor Douglas Boling (WINCMD's author).

To obtain the official entry form, rules, and program files, download ENTER.TXT, WINCMD.EXE, and its function library, WCLIB.WCL, from *PC Magazine*'s Utilities/Tips Forum (GO ZNT:TIPS). If you don't have a modem, you can request the form, rules, and files by mail or phone: Send a postcard to WINCMD Contest, *PC Magazine,* One Park Ave., New York, NY 10016-5802, or call 212-503-4550. (WINCMD was published in the April 27, 1993, issue; WCLIB.WCL, was in the May 25, 1993, issue.)

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Standard IRQ Assignments

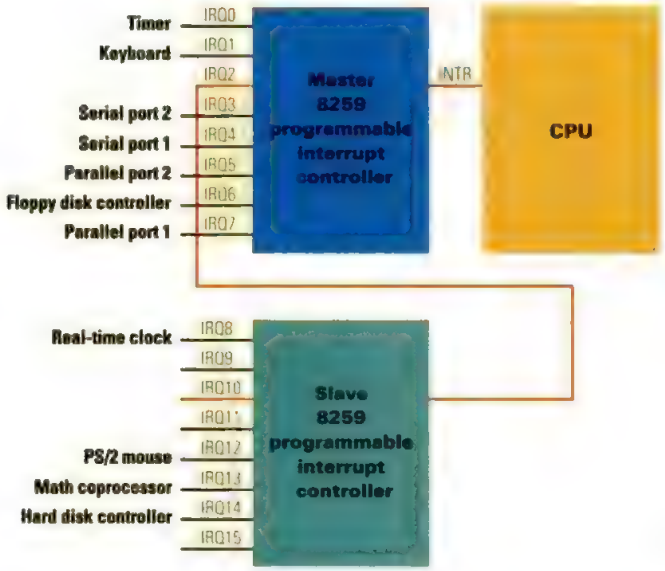

Figure 2: **Shown here are the master and slave 8259 interrupt controllers and the standard IRQ assignments utilized in AT-class platforms.**

IRQ options, simply execute the program with its help switch: `FINDIRQ /h`. The help screen lists and describes all program options.

IRQ REVIEW Before delving into FIND IRQ's inner workings, a brief review of interrupt processing may be helpful. Interrupts provide a time-saving alternative to periodically polling all the peripherals attached to the system to determine whether they require the CPU's attention. Under an interrupt system, peripheral devices receive recognition only when they ask for it. Thus, the system processor does not waste processing time repeatedly checking for characters being typed at the keyboard or data bytes being received by an attached modem.

Devices such as the keyboard controller and the communications UART chip utilize the interrupt lines labeled IRQ0 through IRQ15. These lines go to the 8259 Programmable Interrupt Controllers (PICs), which arbitrate the interrupt requests and then activate the processor's single interrupt request line. A detailed discussion of this process can be found in *The IBM PC from the Inside Out*, by Sargent and Shoemaker (Addison-Wesley, 1984, 1986).

Figure 2 depicts this arrangement and shows the standard IRQ assignments used by an AT-class machine. Each 8259 PIC handles eight interrupt lines; to accommodate additional interrupt lines, multiple 8259s are tied together. One serves as the master and has a cascade line that connects it to slave 8259s. On the AT, IRQ2 is used for this purpose. Note, however, that you can still attach devices that utilize IRQ2. The adapter-card edge connector used for IRQ2 in PC-class machines is wired to IRQ9 in AT machines. It is then routed via a software interrupt to the interrupt for IRQ2. This roundabout arrangement was implemented to provide compatibility with original PC adapter boards.

When each 8259 is initialized, the interrupt base value is written to the PIC. This value determines which interrupt number is generated. The master PIC starts at 8, so IRQs 0 through 7 generate interrupts 8 through 15. The slave PIC starts at 70h, so IRQs 8 thru 15 generate interrupts 70h through 77h. The PIC registers are accessible in I/O space; the master PIC is based at 20h and the slave starts at A0h.

FINDIRQ checks the PIC's Interrupt Mask Register to detect active interrupts. In this 8-bit register, each bit position corresponds to one of the interrupt lines. The BIOS and other device handlers use this register to enable or disable the generation of interrupts. Interrupts are disabled or "masked" when a 1 is written to the corresponding bit position, while a 0 means that they are enabled.

HOW FINDIRQ WORKS FINDIRQ starts by checking the system model ID byte at 0F000:FFFE to ascertain whether the system is an AT-class machine (16 IRQ

lines) or an older, PC-type machine (8 IRQ lines). The program next attempts to read FINDIRQ.DAT, which exists if FINDIRQ has previously been executed as a TSR. The file FINDIRQ.DAT contains 2 bytes (16 bits) that show the IRQs that have at some point been enabled.

After checking the data file, the PIC mask registers are read to determine which IRQs are currently enabled. FINDIRQ maintains its own copies of the PIC mask registers and sets the bits appropriately as it learns about the devices present on the system.

IRQs assigned to COM and LPT devices may not be enabled if the devices are not being used. The INT 11h equipment check call is used to determine the number of COM and LPT ports available, and the IRQs corresponding to these are recorded in the FINDIRQ PIC mask variables. If a mouse is present and its driver is loaded, determining its IRQ is easy: Software interrupt 33h, function 24h returns information about the type of mouse and its IRQ assignment. For PS/2 mice, the IRQ is not returned, but the IRQ assignment is always IRQ12.

If an IRQ is enabled and has a standard system assignment, FINDIRQ can easily display the description for the device. For example, if IRQ6 is enabled, the utility knows that the device description is "Floppy." For optional devices, FIND IRQ displays the name of the device as it is specified by the device driver (for character devices) or the name of the controlling program (in the case of a TSR). In order to do this, FINDIRQ must locate these items in memory.

FINDING THE DRIVER OR TSR The first step in finding a device driver or TSR program is to look at the interrupt vector corresponding to the IRQ. For device drivers, if stacks have been disabled (that is, if STACKS 0,0 has been entered in the CONFIG.SYS file), the vector will provide the address directly. Since most systems have stacks enabled (the default is STACKS 9,128 on AT-class machines), however, the search must usually continue.

When stacks are enabled, DOS intercepts hardware interrupts, and when interrupts occur, DOS sets up a stack from its pool of stacks before dispatching them to the original interrupt handler. This ensures that stack space will not be exhausted during hardware interrupt servicing. Figure 3 shows the techniques

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STACKS Routines

```
;-----------------------------------------------------------
;get_stacks_seg - Determine the segment where the DOS STACKS |
;                 code resides.  This will be used later     |
;                 for tracing back through the STACKS        |
;                 interrupt handlers to find the original    |
;                 ISRs.                                      |
;                                                            |
;             Enter:                                         |
;                     ds = local data segment                |
;                atclassf = TRUE if AT class machine         |
;                 dos_ver = DOS minor ver/major ver          |
;                                                            |
;              Exit:                                         |
;                                                            |
;         dos_handler_seg = segment for DOS STACKS.          |
;                                                            |
;  ds preserved.                                             |
;-----------------------------------------------------------
get_stacks_seg  proc    near
                push    ds
                xor     bx, bx
                mov     ds, bx                  ;vectors
                assume  ds:nothing
;
;Use the segment found in the floppy handler as our default guess of
;where the STACKS code is.
;
;
                mov     bx, [(pcflop + BEG_INTS) shl 2] ;vector for IRQ6
                mov     ax, [bx].d_segment

                cmp     byte ptr cs:dos_ver, 4  ;DOS 4 or better?
                jb      get_stacks800
;
;If DOS 4 or better, memory control block, subsegment control blocks
;can be used to find STACKS.
;
                mov     ah, DOS_LIST_LISTS
                int     21h
                mov     dx, es:[bx - 2]         ;segment of first MCB
                mov     ds, dx
                mov     cx, dx                  ;save it
                xor     bx, bx
                cmp     [bx].mcb_sig, 'M'       ;valid MCB?
                jne     get_stacks800           ;MCBs corrupted

                mov     di, [bx].mcb_size       ;get first size
                inc     di                      ;add para for the MCB
                add     dx, di                  ;after DOS data seg

                inc     cx                      ;1st subsegment block
get_stacks300:
                cmp     cx, dx                  ;at end of info?
                jae     get_stacks800           ;if so, search done
                mov     ds, cx                  ;load the segment
                cmp     [bx].mcb_sig, 'S'       ;STACKS?
                je      get_stacks500
                mov     cx, [bx].mcb_owner
                add     cx, [bx].mcb_size       ;advance to next block
                jmp     short get_stacks300

get_stacks500:
                mov     ax, [bx].mcb_owner
get_stacks800:
                mov     cs:dos_handler_seg,  ax     ;save it
get_stacks900:
                pop     ds
                assume  ds:code
                ret
get_stacks_seg  endp

;-------------------------------------------- ----------------
;ck_for_dos - Given a ptr to an interrupt vector, determine if|
;             the handler is one of those inserted by DOS    |
;             to first check stack before dispatching to     |
;             original ISR.  If it is, attempt to get the    |
;             address of the original ISR.                   |
;                                                            |
;             Enter:                                         |
;                     ds = local data segment                |
;                  es:bx = ptr to vector                     |
;         dos_handler_seg = segment of the DOS handlers      |
;                                                            |
;              Exit:                                         |
;                                                            |
;                Carry set if no DOS handler present or      |
;                           can't find original ISR.         |
;                                                            |
;             else  es:bx = ptr to original ISR              |
;                                                            |
;  All other registers preserved.                            |
;-----------------------------------------------------------
ck_for_dos      proc    near
                push    ax
                push    cx
                push    di

                mov     ax, dos_handler_seg
                cmp     es:[bx].d_segment, ax   ;same seg STACKS?
                jne     ck_for_900
                les     di, es:[bx]             ;es:di = &handler
                mov     al, es:[di]             ;get byte of code

;
;Several different flavors of these stack handlers are used in the
;various iterations of DOS. Look for the following cases:
;
;case 1:                jmp  label
;                       dd   &old_isr
;
;               label:  call handler   ;put offset of &ISR on stack
;                       dw  offset var ;and go get it and call it
;
;
;case 2:                call handler   ;put offset of &ISR on stack
;                       dd   &old_isr
;
;
;case 3:                jmp  label
;                       dd   &old_isr
;
;               label:  ...
;
;                       pushf
;                       cs:
;                       call far [xxxx] ;also this it may not follow the
;                                       ;jmp

;case 4:                push ax
;                       ...
;                       ...
;
;                       pushf
;                       cs:
;                       call far [xxxx]   ;xxxx is the offset of the
;                                         ;variable that holds the &ISR

                cmp     al, OP_JMP      ;is it a jmp
                jne     ck_for_200
                inc     di
                sub     ah, ah
                mov     al, es:[di]     ;get next type of code
                inc     di              ;past 2nd byte of rel jmp
                add     di, ax          ;get to location of jmp

                mov     al, es:[di]     ;get byte of code there
ck_for_200:
                cmp     al, OP_CALL     ;is it a call
                jne     ck_for_300
                mov     di, es:[di + 3] ;offset to dd that holds &ISR
                les     bx, es:[di]     ;&ISR
                jmp     short ck_for_999 ;exit with carry clear

ck_for_300:
                mov     cx, BYTES_TO_SEARCH
ck_for_400:
                mov     al, OP_PUSHF
                repne   scasb           ;pushf instruction?
                jcxz    ck_for_900
                mov     al, OP_CS       ;CS override?
                scasb
                jnz     ck_for_400
                mov     ax, OP_CALL_MEM16
                scasw                   ;call?
                jnz     ck_for_400
                mov     di, es:[di]     ;offset of var that holds &ISR
                les     bx, es:[di]     ;get &ISR

ck_for_800:
                jmp     short ck_for_999 ;exit with carry clear
ck_for_900:
                stc
ck_for_999:
                pop     di
                pop     cx
                pop     ax
                ret
ck_for_dos      endp
```

Figure 3: **These routines identify the segment where the DOS STACKS interrupt handlers reside and retrieve the original interrupt service routine address.**

Search Procedures

1 of 2

```
;-----------------------------------------------------------------
;find_drivers - For all IRQs that are active, look to see if
;               we have a description for the device.  If we
;               don't, the device using this IRQ must be
;               something we don't know about, such as a
;               sound board, SCSI adapter, etc.  In this case,
;               go get the driver name or program name and
;               put it in the description for the IRQ.
;
;               In the event that a driver or TSR (with
;               PSP) is not found, assign "Other" for the
;               device description.
;
;          Enter:
;                  ds=local data segment
;                 atclassf = TRUE if AT class machine
;
;                 pic_mask = PIC mask values.
;
;          device_desc = offset to array of description
;                        offsets.
;
;           Exit:
;
;  ds, bp preserved, es trashed.
;-----------------------------------------------------------------
find_drivers    proc    near
                push    bp
                mov     ah, DOS_LIST_LISTS
                int     21h             ;get es:bx ptr to lists

                cmp     dos_ver, 0003h  ;DOS 3.0?
                jne     find_drv_050
                lea     bx, es:[bx].nul_dev_head30 ;ptr to NUL device
                jmp     short find_Drv_080
find_drv_050:
                lea     bx, es:[bx].nul_dev_head   ;ptr to NUL device
find_drv_080:
                mov     ax, es
                mov     drv_ptr.d_segment, ax   ;save ptr to start
                mov     drv_ptr.d_offset, bx    ;of driver chain

                xor     al, al                  ;IRQ counter
                mov     bp, pic_mask
                mov     cx, 16                  ;16 IRQs on AT
                cmp     atclassf, TRUE          ;AT machine?
                je      find_drv_100
                shr     cx, 1                   ;only 8 IRQs on PC
find_drv_100:
                shr     bp, 1                   ;check IRQ
                jc      find_drv_600            ;skip if not active
find_drv_110:
                call    get_desc_entry          ;description for IRQ
                xor     bx, bx
                cmp     [di], bx                ;is there one?
                je      find_drv_125
;
;If there is already a description for the device, don't need to look
;for driver.  However, there is one exception.  If we are on an AT,
;we always assign an initial description of "cascade" to IRQ2.  If
;that is the only description we have (e.g. we haven't got a mouse on
;IRQ2, etc.), go ahead and look for a driver using IRQ2.
;
                cmp     atclassf, TRUE          ;AT machine?
                jne     find_drv_600            ;if not, no cascade
                cmp     al, 2                   ;doing IRQ2?
                jne     find_drv_600            ;if not, no test
                cmp     [di + 2], bx            ;check 2nd desc (bx=0)
                jne     find_drv_600
                add     di, 2                   ;next desc entry

find_drv_125:
                mov     es, bx                  ;point to vector

                mov     bl, al                  ;irq number
                cmp     al, 8
                jb      find_drv_150
                add     bl, (BEG_SLAVE_INTS - 8)
                jmp     short find_drv_175

find_drv_150:
                add     bl, BEG_INTS
find_drv_175:
                shl     bx, 1
                shl     bx, 1                   ;offset into vectors
;See if pointing to DOS stack handlers.  If so, carry is not set and
;es:bx points to address of original ISR.
;
                call    ck_for_dos
                jnc     find_drv_200            ;es:bx point to ISR
                les     bx, es:[bx]             ;point to ISR
find_drv_200:
                call    load_drv_desc
find_drv_600:
                inc     al                      ;advance IRQ counter
                loop    find_drv_100
find_drv_900:
                pop     bp
                ret
find_drivers    endp

;-----------------------------------------------------------------
;load_drv_desc - Retrieve and load driver description.
;
;          Enter:
;                  ds=local data segment
;                  di=offset of entry for description
;                es:bx=ptr to ISR for which description is
;                      needed.
;        device_desc = offset to array of description
;                      offsets.
;       drv_desc_ptr = offset of next work description area.
;
;           Exit:
;                 [di]=offset of description.
;         drv_desc_ptr advanced to next work description area.
;
;  all registers saved.
;-----------------------------------------------------------------
load_drv_desc   proc    near
                push    ax              ;save picmask/IRQ counter
                push    cx              ;save loop count
                push    di              ;save offset of desc entry

                push    bx                      ;save offset
                mov     dx, es                  ;address in dx:bx
                call    is_it_driver            ;see if driver or TSR
                pop     dx                      ;get back offset (bx)
                jnc     load_drv_300            ;jmp if not a driver
                mov     dx, offset block_desc   ;"Block Device"
                cmp     al, 2                   ;IRQ2? if so, may have
                jne     load_drv_290            ;"Cascade" if AT - use
                mov     dx, offset block_abbrv  ;abbrev desc to fit

load_drv_290:
                test    es:[bx].dev_attrib, 8000h ;char driver?
                jz      load_drv_550    ;if not, use "Block Device"
                call    mov_char_name   ;if so, move char device name
                jmp     short load_drv_450
load_drv_300:
;
;Wasn't a driver.  Must be a TSR.  Using the pointer to environment
;from the TSR's PSP, find the name of executable.
;
;
                mov     bx, dx                  ;offset of ISR
                call    determine_psp           ;return nc if PSP found
;
;If a PSP is found, carry will NOT be set.  Also, if PSP is found, and
;ax is nonzero, ax holds the segment of the environment.  If ax is
;zero then the environment was freed.  If such cases, es:bx will be
;returned as a pointer to the filename description in the MCB
; (if DOS is 4.x or better - otherwise bx=0)
;
                jnc     load_drv_350
load_drv_330:
                mov     dx, offset other_desc   ;can't get filename
                jmp     short load_drv_550      ;so, go assign "Other"
load_drv_350:
                or      ax, ax                  ;environment found?
                jnz     load_drv_370            ;if so, get filename
                or      bx, bx                  ;name in MCB?
                jz      load_drv_330            ;if not, print "Other"
                jmp     short load_drv_400      ;go get name
load_drv_370:
                mov     es, ax
                call    retrieve_path           ;get ptr to filename
                jc      load_drv_330            ;if data not right
load_drv_400:
                mov     di, drv_desc_ptr
                mov     dx, di                  ;save desc offset
                call    mov_file_name
load_drv_450:
                mov     al, STR_TERM
                stosb                           ;terminate it
                add     drv_desc_ptr, size drv_descrip
load_drv_550:
                pop     di
                pop     cx
                pop     ax
```

Figure 4: **The procedures listed above are used to search the driver and MCB chains.**

Search Procedures

2 of 2

```
                mov     [di], dx                ;store offset of name
                ret
load_drv_desc   endp

;-----------------------------------------------------------
;determine_psp - An ISR was found and it is not part of a     |
;                device driver.  Search the MCB chain for     |
;                PSP associated with code that would contain  |
;                the ISR.  If found, check the environment    |
;                entry for the PSP.  If environment has not   |
;                been freed, return ax=environment segment. If |
;                not found and DOS is 4.x or better, return   |
;                es:bx as ptr to filename in MCB.             |
;                                                             |
;          Enter:                                             |
;                 es:bx = ptr to ISR                          |
;                                                             |
;           Exit:                                             |
;                    cy set if PSP NOT found else nc          |
;                    also if found ax=environment seg (zero   |
;                                    if it was freed)         |
;                                                             |
;                        if found and ax=0, es:bx=ptr         |
;                                      to filename in MCB     |
;                                      (zero if < DOS 4)      |
;                                                             |
;   ds preserved.                                             |
;-----------------------------------------------------------
determine_psp   proc    near
                push    ds
                mov     dx, es                  ;segment of ISR
                mov     cl, 4
                shr     bx, cl                  ;convert to paragraphs
                add     dx, bx                  ;para location of code

                mov     ah, DOS_LIST_LISTS
                int     21h
                mov     di, es:[bx - 2]         ;segment of first MCB
                mov     es, di
                xor     bx, bx                  ;offset zero in MCB
                mov     si, es                  ;save MCB segment
determine_p200:
                inc     si                      ;ready for next one

                cmp     es:[bx].mcb_sig, 'Z'    ;at end of chain?
                je      determine_p900          ;if so, not found
                cmp     es:[bx].mcb_sig, 'M'    ;valid entry?
                jne     determine_p900          ;if not, MCBs wrong

determine_p300:
                mov     cx, es:[bx].mcb_owner   ;get MCB owner seg
                mov     di, cx                  ;save it
                mov     ax, es:[bx].mcb_size    ;and its size
                cmp     cx, si                  ;is this a PSP?
                jne     determine_p700          ;if not, go next PSP

                cmp     dx, cx                  ;compare segment
                jb      determine_p700          ;beneath the segment
                add     cx, ax                  ;get end of the area
                cmp     dx, cx
                ja      determine_p700          ;above the segment

                assume  ds:nothing
                mov     ds, di                  ;ds=seg of owner
                mov     ax, [bx].psp_environ_seg

                or      ax, ax                  ;freed environment?
                jz      determine_p400          ;if so, try plan b

                dec     ax                      ;1 paragraph back
                mov     ds, ax                  ;is seg of MCB for it
                inc     ax                      ;back to "environment"
                cmp     [bx].mcb_owner, di      ;belongs to PSP?
                je      determine_p999          ;yes, exit nc, ax=seg
determine_p400:
                xor     ax, ax                  ;indicate none
                cmp     byte ptr cs:dos_ver, 4  ;DOS 4 or better?
;
;if yes, we can return filename
;if not, bx=0 indicating must print "Other"
;
                cmc                             ;carry clear if < DOS 4
                jnb     determine_p999          ;nc and bx=0 if < DOS 4
determine_p500:
                clc
                lea     bx, es:[bx].mcb_fname
                jmp     short determine_p999    ;nc, es:bx = &filename
determine_p700:
                add     si, ax                  ;get to next MCB
                mov     es, si
                jmp     short determine_p200
determine_p900:
                stc
determine_p999:
                assume  ds:code
                pop     ds
                ret
determine_psp   endp
```

used to identify the code segment of the DOS STACKS interrupt handlers. Also shown in Figure 3 is the way FINDIRQ inspects the code in those handlers as it looks for the original interrupt service routine (ISR) address.

For later versions of DOS, FINDIRQ takes advantage of the memory control block's subsegment control blocks (these only exist in DOS 4.0 and later). FINDIRQ uses the undocumented "list of lists," DOS function 52h, to establish a pointer to the memory control block (MCB) chain. Using the subsegment control blocks within the MCBs, the STACKS entry can be located, yielding the segment of the STACKS area. (For more information, see the June 12, 1990, Utilities column.)

FINDING THE NAME Once the ISR address is determined, FINDIRQ searches the DOS device driver chain for an entry whose code segment matches that of the interrupt handler. Again, the "list of lists" DOS function is utilized, this time to retrieve the pointer to the DOS driver chain. Andrew Schulman's text, *Undocumented DOS* (Addison Wesley, 1990), contains an excellent discussion of the requisite techniques. If a match is found in the driver chain and if the driver is a character device driver, FINDIRQ copies the name of the device contained in the device driver header into its description area. For block devices, which are referenced by drive letters instead of device names, "Block Device" is used as the description. If the ISR address does not belong to a device driver, it presumably belongs to a TSR. Thus the next step is to search the MCB chain for entries that point to executable code.

The procedures used for searching the driver and MCB chains are listed in Figure 4. All programs loaded by DOS begin with a program segment prefix (PSP), the information that includes a pointer to the program's copy of the environment. The job at hand is to locate the PSP for the TSR.

The 16-byte MCB immediately precedes the block of memory it describes. Within each MCB is one field that contains the PSP segment of the program that owns the memory block and another field that tells how large the block is. If the block of memory described by the MCB is also the owner, then the block contains a program; it's not an environment block or another allocated chunk of memory. If the ISR address falls in the block of memory (as defined by its size), then the TSR is found. Once the TSR is located, the PSP's pointer to the environment is used to retrieve the program name. With DOS 3.0 and later, the pro-

gram name is stored in the last portion of the environment block.

One complication that can arise here is that the environment may have been freed by the TSR. In such a case, the address space may actually contain the environment for another program. To ensure that it has the right environment, FIND IRQ compares the owner field of the MCB for the environment with the PSP segment. If these are different, the environment has been freed. Even in such a case, however, the program name can sometimes still be retrieved; DOS versions 4.0 and later place the program name in the MCB itself. If all else fails, FINDIRQ uses "Other" for the description of the program that handles the interrupt. IRQ usage that can only be detected with FINDIRQ's TSR component will usually list "Other" as its description.

TSR APPROACH When FINDIRQ is invoked with the TSR option, it becomes resident in the system and monitors the enabling of IRQs in the 8259 PIC interrupt mask registers. The TSR component of FINDIRQ chains into the user timer interrupt (INT 1Ch), and the PIC mask registers are read approximately once a second. When a new IRQ is enabled, FINDIRQ sets a flag so that it can update its .DAT file when it is safe to do so. Interrupt 28h, the DOS idle handler, provides the means of detecting the period in which it is safe to use DOS functions from within a TSR (see "The Inner Life of a TSR," *PC Magazine*, August 1990). As mentioned earlier, this data file is read by FINDIRQ when it is invoked to display IRQ status information.

SUMMARY Adding new devices to your system can be a challenge. The difficulties are sufficient to have prompted Microsoft to spearhead development of the Plug and Play Industry Standard Architecture Specification, which may someday make manual configuration obsolete. In fact, IBM's MCA architecture already supports "plug and play," though it is not in wide use. But until automatic configuration becomes a standard, the next time you need to add a peripheral that uses an IRQ, fire up FINDIRQ and make your IRQ selection with ease. □

RICK KNOBLAUGH IS A FREQUENT CONTRIBUTOR TO *PC MAGAZINE*.

QUICK REFERENCE GUIDE

FINDIRQ Command

Rick Knoblaugh

September 28, 1993 (Utilities)

Purpose: Reports which interrupt request lines (IRQs) in a system are assigned to specific devices and which are free to use for installing a new peripheral device.

Format: `[LH] FINDIRQ [/t] [/i] [/u] [/d] [/h]`

Remarks: Executed from a DOS prompt and without any of its optional parameters, FINDIRQ identifies installed standard (AT) IRQ devices and optional character devices by device name. Optional block devices are designated by "Block Device." TSR-controlled devices are identified by their program names.

The command `FINDIRQ` will detect devices controlled by TSR programs that are loaded in conventional memory. Devices controlled by TSRs loaded in high memory require entering the command as `LH FINDIRQ`. Since this latter command form also detects conventionally sited TSRs, `LH FINDIRQ` should be used on systems that use high memory.

Peripherals such as sound boards, whose IRQ numbers are enabled only when the devices are active, can be detected only by activating them while FINDIRQ is memory-resident. The command `FINDIRQ /t` installs the utility as a TSR; `FINDIRQ /u` uninstalls it. While memory-resident, FINDIRQ records IRQs in the file FINDIRQ.DAT, which is read before displaying its on-screen report. Since any configuration changes render the previous contents of FINDIRQ.DAT obsolete, the data file can be reinitialized by entering `FINDIRQ /i`.

FINDIRQ verifies its interrupt information before presenting it. In some circumstances, however, such as when an IRQ is enabled under Windows but no DOS interrupt handler is located, no verification is possible, so the interrupt will appear to be free when it is not. To check for such a possibility, the verification requirement can be turned off with the command `FINDIRQ /d`.

Finally, a help screen can be displayed by entering `FINDIRQ /h`. Both the executable FINDIRQ.COM and its assembly language source files can be downloaded from PC MagNet. A Microsoft MASM assembler (or compatible), LINK, and EXE2BIN are required if the program is to be rebuilt.

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Installing Traffic Lights Under Windows NT

BY CHARLES PETZOLD

About once a year, the traffic lights at the busy intersection outside my apartment window stop working. The result is chaos, and while the cars usually avoid actually hitting each other, they often come close.

We might term the intersection of two roads as a "critical section." A southbound car and a westbound car cannot pass through an intersection at the same time without hitting each other. Depending on the traffic volume, different approaches are taken to solve the problem. For very light traffic at an intersection with high visibility, drivers can be trusted to yield properly to one another. More traffic might require a stop sign, and still heavier traffic might require traffic lights, which (so long as they work, of course) can help coordinate the activity of the intersection.

PROGRAMMING FOR INTERSECTIONS Under a single-tasking operating system, computer programs don't need traffic lights to help them coordinate their activities. They run as if they owned the road, which they do, because there are no other programs to interfere with them. Even under a multitasking operating system, most programs run more or less independently of one another. Such problems as might arise (for example, two programs trying to read from or write to the same file at the same time) can be handled by fairly simple mechanisms (in this case, file sharing and record locking).

In a multithreaded operating system such as Windows NT, however, the situation becomes messy and potentially dangerous. In this case, the program may split itself into multiple threads of execution. The operating system switches control among these threads just as it switches control among all the other programs running under the system, so that threads seem to run concurrently. In a multithreaded program, it is not uncommon for two or more threads to share some data. For example, one thread might update one or more variables for another thread to use. Sometimes this poses a problem.

Keep in mind that the operating system can only switch control from one thread to another *between* machine code instructions. If the variable being shared between threads is a single integer variable, any changes to it are likely to occur in a single instruction. Potential problems are minimized. But suppose that the threads share several variables or an entire data structure. Often these multiple variables (or the fields of the data structure) must be consistent among themselves, and this takes multiple instructions. If the operating system interrupts the thread in the middle of the process of updating these variables, the thread that uses those variables would then be forced to use inconsistent data. The result is a collision, and it's not difficult to imagine how an error like this might well crash the program.

Four sample multithreaded programs illustrate various mechanisms for preventing threads from colliding under Windows NT.

What we need to prevent such a mishap is the programming equivalent of a traffic light, something that could help coordinate and synchronize the thread traffic. Fortunately, Windows NT offers a variety of mechanisms to help programmers prevent thread collisions. We'll begin to examine them in this column.

THE SAMPLE PROGRAM To keep the code examples short and clear, I'm going to use a rather artificial example. In this program, two threads share a global array of five integers. One thread continuously updates the elements of this array to the same value and then increments that value for the next update. The other thread uses the printf function to display the five elements of the array.

The first version of this program is called SYNC1, shown in Figures 1 and 2. (You can download the source code and executables for all versions of this program from the Programming Forum on PC MagNet, archived as SYNC.ZIP.) If

SYNC1.MAK
Complete Listing

```
#---------------------
# SYNC1.MAK make file
#---------------------

!include <ntwin32.mak>

sync1.exe : sync1.obj
     $(link) $(conflags) -out:sync1.exe sync1.obj $(conlibsmt)

sync1.obj : sync1.c
     $(cc) $(cflags) $(cvarsmt) sync1.c
```

Figure 1: SYNC1.MAK is a make file for compiling and linking SYNC1.C.

SYNC1.C

Complete Listing

```
/*----------------------------------------
   SYNC1.C -- NT Synchronization Demo #1
         (c) Charles Petzold, 1993
  ----------------------------------------*/

#include <process.h>
#include <stdio.h>

int a [5] ;

void Thread (void * pParams)
     {
     int i, num = 0 ;

     while (1)
          {
          for (i = 0 ; i < 5 ; i++)
               a [i] = num ;

          num++ ;
          }
     }

int main (void)
     {
     _beginthread (Thread, 0, NULL) ;

     while (1)
          printf ("%d %d %d %d %d\n", a[0], a[1], a[2], a[3], a[4]) ;

     return 0 ;
     }
```

Figure 2: **SYNC1.C is the unsynchronized version of the update and display program.**

you have NT and the NT developer's kit installed, you can compile this program from a command line using

```
NMAKE SYNC1.MAK
```

As I've discussed in previous columns, make files for Windows NT programs generally use macro variables defined in NTWIN32.MAK. These macro variables indicate the compiler and linker names, command line switches, library names, and so forth. This system allows the same make file to be used on RISC machines that run Windows NT as well as on Intel-based PCs.

SYNC1 is the unsynchronized version of the program. On entry into the main function, SYNC1 creates a second thread of execution by calling the _beginthread function. As I've mentioned in the past two columns, _beginthread is part of Microsoft's extensions to its C runtime library and is defined in PROCESS.H. The main function then enters an infinite loop to display the five elements of the global array in a line of output using a single printf statement.

The second thread (called Thread) also enters an infinite loop, updating the five elements of the array to the same value and then incrementing that value. Because this is a console program, you can halt the output using Ctrl-S, resume it with Ctrl-Q, and terminate the program using Ctrl-C. The second thread continues to run even if you halt the output of the primary thread.

The output you'll see depends on when Windows NT switches control between the two threads, and this depends on a lot of different factors, such as the speed of your machine, what other programs you happen to be running, and so forth. What you almost definitely won't see is what you may naively hope for—a line of five 0s, a line of five 1s, a line of five 2s, and so on.

You'll probably first see multiple lines of zeros, indicating that the primary thread—that is, the main function—is simply printing the uninitialized elements of the array. After these multiple lines of zeros, you'll then see multiple lines with a higher number. What has happened in the interim is that NT has switched control to the second thread (the Thread function), and that thread has updated the array many times before the system switched control back to the primary thread.

Look closely at the output and you'll also see a run of multiple lines where the numbers are not the same—something like, for example:

```
2531 2531 2530 2530 2530
```

This is precisely the type of problem I discussed earlier: One thread is updating the values and the other thread is using them, except that Windows NT has switched control in the middle of the update process. In this particular case, the second thread only had occasion to update the first two elements of the array, and thus the numbers are not consistent.

You might also see a case where the values in a single line change by quite a lot. In this case, the primary thread has been interrupted in the middle of the printf statement. Although that line of code looks like a single statement, it compiles into a whole series of machine code instructions, which could be interrupted at any time.

USING CRITICAL SECTIONS One relatively simple technique for dealing with problems like these involves defining "critical sections" in the program. Basically, a critical section is a block of code that should not be interrupted. The Windows NT technical documentation indicates that the use of critical sections is faster and more efficient than other synchronization mechanisms (which I'll discuss later).

There are four functions for using critical sections. To use these functions, you must define a critical section object, which is a static variable of type CRITICAL_SECTION—for example:

```
CRITICAL_SECTION cs ;
```

The CRITICAL_SECTION data type is defined in WINBASE.H as being the same as RTL_CRITICAL_SECTION, which is defined in WINNT.H as a structure of five fields. These fields are not documented, indicating that they are used exclusively by the operating system and not by programs.

SYNC2.MAK

Complete Listing

```
#---------------------
# SYNC2.MAK make file
# -----------  -------

!include <ntwin32.mak>

sync2.exe : sync2.obj
     $(link) $(conflags) -out:sync2.exe sync2.obj $(conlibsmt)

sync2.obj : sync2.c
     $(cc) $(cflags) $(cvarsmt) sync2.c
```

Figure 3: **SYNC2.MAK is a make file for compiling and linking SYNC2.C.**

The critical section object must first be initialized by one of the threads in the program, by calling

```
InitializeCriticalSection(&cs);
```

The on-line documentation for this function includes the following warnings: "A critical section object cannot be moved or copied. The process must also not modify the object, but must treat it as logically opaque." The term "logically opaque" is a new one on me, but indicates that Microsoft is beginning to rival IBM in inventing new computer-speak. Basically, the warnings translate as "Don't mess around with it, and don't even look at it."

After the critical section object has been initialized, a thread enters a critical section by calling:

```
EnterCriticalSection(&cs);
```

At this point, the thread is said to "own" the critical section object. No two threads can own the same critical section object at the same time. Thus, if another thread has entered a critical section, the next thread calling EnterCriticalSection will be suspended in the function call. The function will return only when the first thread leaves the critical section by calling

```
LeaveCriticalSection(&cs);
```

At that time the second thread—suspended in its call to EnterCriticalSection—will own the critical section, and the function call will return.

When the critical section object is no longer needed by the program, it can be deleted by calling

```
DeleteCriticalSection(&cs);
```

This frees up any system resources that may have been allocated to maintain the critical section object.

If you're familiar with critical sections in OS/2, you'll note that NTs are a bit different. The OS/2 functions DosEnterCritSec and DosExitCritSec take no parameters. Whenever an OS/2 thread enters a critical section, all the other threads in the process are halted until the first thread exits the critical section.

By contrast, the Windows NT critical section mechanism uses the principle of "mutual exclusion," a term that will come up again as we continue to explore thread synchronization. NT's critical sections are more flexible than the OS/2 equivalents: Only one thread can own a critical section at any time, but other threads in the program continue to run normally. Moreover, you can define multiple critical section objects. For example, suppose a program has four threads. If the first two threads share some data, they can use one critical section object, while the other two threads (which share some other data) can use a second critical section object.

PREVENTING THREAD COLLISIONS Now let's see how we can put critical sections to use in this sample program. The revised version is called SYNC2 and is shown in Figures 3 and 4.

The CRITICAL_SECTION variable is defined globally. The main function in SYNC2.C begins by calling InitializeCriticalSection before creating the second thread. The primary thread calls EnterCriticalSection before calling printf, and LeaveCriticalSection after the printf call. The second thread also calls these two functions to enforce a critical section for the loop that initializes the array. The end result is that the second thread cannot be interrupted while initializing the array, and the first thread cannot be interrupted while displaying the results. All rows of the program output should be consistent.

Note that the SYNC2 program does not call the DeleteCriticalSection function. This is unnecessary because the program uses the critical section for as long as it is running. When the program terminates, the system resources required for maintaining the critical object are deleted automatically.

One limitation of critical sections is that they may only be used for coordinating threads within a single process. There are cases where you need to coordinate two different processes that share a resource (such as shared memory). You can't use critical sections for that, and instead you use something oddly called a "mutex object."

THE MUTEX OBJECT The fabricated word "mutex" stands for "mutual exclusion," and that's precisely our goal here. We want to prevent threads of a program from being interrupted while updating or using some shared data. Or, to use my earlier analogy, we want southbound traffic and westbound traffic mutually excluded from the intersection.

There are only three functions with the word "Mutex" in their names, but other functions (specifically, five functions with the word "Wait" in their names) are involved when you use mutex objects.

The first mutex function creates the mutex object

```
hMutex = CreateMutex (&sa, fOwned,
 pszName);
```

The first parameter is a pointer to a structure of type SECURITY_ATTRIBUTES. You use this parameter if the mutex object is to be shared among processes. For a mutex in a single process, you can set the parameter to NULL. Set the second parameter to TRUE if you want the calling thread to own the mutex object as it's created, or set it to FALSE otherwise. The third parameter is a name of the mutex ob-

ject, which is also used when sharing a mutex object among processes. Set the parameter to NULL if you don't need to name the mutex. The function returns a handle to the mutex object.

The second mutex function (OpenMutex) allows another process to get access to the mutex object by specifying its name and some other information. As with critical section objects, only one thread can own a mutex object at any time. The second parameter to CreateMutex determines whether the calling thread owns the mutex object at creation.

A thread can request ownership by calling one of the five Wait functions. Probably the most common—if anything that is in Windows NT can be called common at this time—is

```
WaitForSingleObject (hMutex,
 dwTimeOut) ;
```

where the first parameter is the mutex handle returned from CreateMutex, and the second parameter is a time-out value.

I'll first discuss the case when this second parameter is set to INFINITE. If the mutex object is currently owned, when a thread calls the WaitForSingleObject function, the thread is suspended until the mutex object is no longer owned. Only at this point will the function return. If the mutex object is not currently owned, the function obtains ownership of the thread and returns.

The second parameter to WaitForSingleObject specifies a time-out value in milliseconds. In that case, if the mutex object is currently owned and the time-out value elapses, then the function returns. You can determine if the time-out elapsed by checking if the return value of the function is WAIT_TIMEOUT.

SYNC2.C

Complete Listing

```
/*----------------------------------------
   SYNC2.C -- NT Synchronization Demo #2
         (c) Charles Petzold, 1993
  ----------------------------------------*/

#include <windows.h>
#include <process.h>
#include <stdio.h>

CRITICAL_SECTION cs ;

int a [5] ;

void Thread (void * pParams)
     {
     int i, num = 0 ;

     while (TRUE)
          {
          EnterCriticalSection (&cs) ;

          for (i = 0 ; i < 5 ; i++)
               a [i] = num ;

          LeaveCriticalSection (&cs) ;

          num++ ;
          }
     }

int main (void)
     {
     InitializeCriticalSection (&cs) ;

     _beginthread (Thread, 0, NULL) ;

     while (TRUE)
          {
          EnterCriticalSection (&cs) ;
          printf ("%d %d %d %d %d\n", a[0], a[1], a[2], a[3], a[4]) ;
          LeaveCriticalSection (&cs) ;
          }

     return 0 ;
     }
```

Figure 4: **SYNC2.C uses critical sections to avoid thread collisions.**

A thread can release ownership of a mutex object by calling

```
ReleaseMutex (hMutex) ;
```

At that time, a thread suspended in a Wait function call is free to run.

THE MUTEX ALTERNATIVE Critical sections are a special form of mutexes, so it should be fairly easy to convert our little program to use them. SYNC3, which was revised to use mutexes, is shown in Figures 5 and 6.

The handle to the mutex is stored in a global variable. The CreateMutex function has replaced InitializeCriticalSection. WaitForSingleObject has replaced EnterCriticalSection. And ReleaseMutex has replaced LeaveCriticalSection. Simple enough?

One problem still remains: We'd probably prefer the numbers displayed by the program to increment by 1 from line to line. As it is, the primary thread gets some time to display identical lines

SYNC3.MAK

Complete Listing

```
#---------------------
# SYNC3.MAK make file
#---------------------

!include <ntwin32.mak>

sync3.exe : sync3.obj
     $(link) $(conflags) -out:sync3.exe sync3.obj $(conlibsmt)

sync3.obj : sync3.c
     $(cc) $(cflags) $(cvarsmt) sync3.c
```

Figure 5: **SYNC3.MAK is a make file for compiling and linking SYNC3.C.**

over and over, and then the second thread gets some time to initialize the array and increment the number over and over. It would be nice if the threads could signal each other that they can now do their jobs. That is, after the primary thread displayed the row of numbers, it could signal the second thread to update the array, and then wait. When the second thread was finished updating, it could signal the primary thread to display the updated results, and then wait until it received a signal back. Sound useful? This is a job for the "event object."

THE EVENT OBJECT Windows NT event objects work just about the way I described them above. You use the WaitForSingleObject (or one of the other Wait functions) with event objects. If the event object is in a signaled state, WaitForSingleObject returns. If the event object is in an unsignaled state, the function waits until the event object becomes signaled.

You create the event object by calling

```
hEvent = CreateEvent (&sa, fManual,
fInitial, pszName) ;
```

The first and last parameters are the same as those for CreateMutex and can be set to NULL if the events are not to be shared among processes.

If you set the fManual parameter to FALSE, the event object becomes automatically unsignaled when the WaitForSingleObject function returns. That is, another call to the WaitForSingleObject function (without anything happening to the even object in the interim) will suspend the thread. If you don't want WaitForSingleObject to make the event object unsignaled on return, set this parameter to TRUE. Set the fInitial flag to TRUE if you want the event object to be initially signaled, and to FALSE for it to be initially unsignaled.

The OpenEvent function is used by another process to get a handle to the event object, if processes must share the same event.

The following function signals an event object:

```
SetEvent (hEvent) ;
```

and this function resets the state to unsignaled:

```
ResetEvent (hEvent) ;
```

You need to use ResetEvent if you set the fManual parameter of CreateEvent to FALSE.

The PulseEvent call sets the event object to a signaled state, and then back to unsignaled after threads have been released from their WaitForSingleObject calls. (All waiting threads are released for a manual-reset event object, but only one waiting thread is released for an automatic-reset event object.)

To see how this looks in practice, take a look at the SYNC4 program that is shown in Figures 7 and 8. As you can see,

SYNC4.MAK

Complete Listing

```
#---------------------
# SYNC4.MAK make file
#---------------------

!include <ntwin32.mak>

sync4.exe : sync4.obj
     $(link) $(conflags) -out:sync4.exe sync4.obj $(conlibsmt)

sync4.obj : sync4.c
     $(cc) $(cflags) $(cvarsmt) sync4.c
```

Figure 7: **SYNC4.MAK is a make file for compiling and linking SYNC4.C.**

SYNC3.C

Complete Listing

```
/*----------------------------------------
   SYNC3.C -- NT Synchronization Demo #3
         (c) Charles Petzold, 1993
  ----------------------------------------*/

#include <windows.h>
#include <process.h>
#include <stdio.h>

HANDLE hMutex ;

int a [5] ;

void Thread (void * pParams)
     {
     int i, num = 0 ;

     while (TRUE)
          {
          WaitForSingleObject (hMutex, INFINITE) ;

          for (i = 0 ; i < 5 ; i++)
               a [i] = num ;

          ReleaseMutex (hMutex) ;

          num++ ;
          }
     }

int main (void)
     {
     hMutex = CreateMutex (NULL, FALSE, NULL) ;

     _beginthread (Thread, 0, NULL) ;

     while (TRUE)
          {
          WaitForSingleObject (hMutex, INFINITE) ;
          printf ("%d %d %d %d %d\n", a[0], a[1], a[2], a[3], a[4]) ;
          ReleaseMutex (hMutex) ;
          }

     return 0 ;
     }
```

Figure 6: **SYNC3.C uses mutex objects to avoid thread collisions.**

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SYNC4.C

Complete Listing

```
/*----------------------------------------
   SYNC4.C -- NT Synchronization Demo #4
         (c) Charles Petzold, 1993
  ----------------------------------------*/

#include <windows.h>
#include <process.h>
#include <stdio.h>

HANDLE hEvent1, hEvent2 ;

int a [5] ;

void Thread (void * pParams)
     {
     int i, num = 0 ;

     while (TRUE)
          {
          WaitForSingleObject (hEvent2, INFINITE) ;

          for (i = 0 ; i < 5 ; i++)
               a [i] = num ;

          SetEvent (hEvent1) ;

          num++ ;
          }
     }

int main (void)
     {
     hEvent1 = CreateEvent (NULL, FALSE, TRUE,  NULL) ;
     hEvent2 = CreateEvent (NULL, FALSE, FALSE, NULL) ;

     _beginthread (Thread, 0, NULL) ;

     while (TRUE)
          {
          WaitForSingleObject (hEvent1, INFINITE) ;
          printf ("%d %d %d %d %d\n", a[0], a[1], a[2], a[3], a[4]) ;
          SetEvent (hEvent2) ;
          }

     return 0 ;
     }
```

Figure 8: **SYNC4.C uses event objects to fully synchronize the threads.**

the main function creates two event objects. Both will automatically reset, but the first is initially signaled, and the second is initially unsignaled. The second thread is then created. However, the second thread can't update the numbers because it enters a WaitForSingleObject call for the second event object, which is unsignaled.

The primary thread also calls WaitForSingleObject, but for the first event object. That event object was initialized to a signaled state, so WaitForSingleObject returns, in the process resetting the event object to an unsignaled state. The primary thread displays the numbers and then calls SetEvent for the second event object. The primary thread can't display any more numbers yet, because it calls WaitForSingleObject for the first event object, which is now unsignaled.

This is the opportunity the second thread has been waiting for! It returns from the WaitForSingleObject call, updates its numbers, and calls SetEvent for the first event object. Another call to WaitForSingleObject suspends the execution of the thread, but now the primary thread is allowed to display the updated numbers.

The thread control goes back and forth this way, almost like a traffic light that lets through only one car at a time. The numbers increment uniformly.

We'll take another look at thread synchronization in the next issue. And I promise you this: No more traffic-light analogies! □

Solutions

TIPS AND TECHNIQUES TO INCREASE YOUR PRODUCTIVITY

PCs

FINDING THE RIGHT VIDEO DRIVER

? I purchased a 386DX/33 computer system in October of 1992. It came with high-resolution video drivers for Windows 3.0 but not Windows 3.1, which I have since purchased. The company that sold me the system told me that the drivers shipped with the system work fine with Windows 3.1. When I explained that the drivers weren't working on my machine, they seemed unable to suggest a solution. How can I get high-resolution drivers that work?

Edgar Haecker
Mississauga, Ontario, Canada

▶**PC MAGAZINE:** There are a number of places to find video drivers. Chances are good that your video adapter was sold as a component to the manufacturer of your system. Open the case and examine the card for any copyright markings that might indicate who the original manufacturer is. You can then contact that company directly; many have bulletin board systems where you can download the latest drivers for the price of a phone call.

If you can't determine the board manufacturer, try the VGA chip-set manufacturer. The chip set will be one of the largest chips on the board, and likely candidates include ATI Technologies, C3, Cirrus, Tseng Laboratories, Weitek Corp., and Western Digital Corp. Manufacturers have different policies about providing drivers and support for end users. For example, Tseng doesn't support end users, since it feels that's the responsibility of the board manufacturer. As a service, however, the company does post some generic drivers on CompuServe (GO TSENG) and America Online (KEYWORD TSENG).

If you still haven't found what you need, check the Video Drivers library in Microsoft's WINADV (Advanced Windows) Forum on CompuServe, where you'll find the latest versions of drivers for a wide range of boards and chip sets.

Finally, Panacea sells a product called WinSpeed, which is a collection of drivers designed to get optimum performance in 256-color modes for a variety of the most commonly used video chip sets. Call the company at 800-729-7420 or 603-437-5022 for more information.

—*Alfred Poor*

Peripherals

POST-ITS MAKE PRINTING EASIER

TIP I often have to feed single sheets of card-stock paper into my dot matrix printer. Usually, it will give an out-of-paper message before all the text is printed. Disabling the out-of-paper switch isn't a good solution; near the bottom of the page, the friction feed will fail, and the last few lines will be garbled.

My solution is to put two 3- by 3-inch Post-It notes on the back of the paper. I place them at the outer edges where they'll engage the friction-feed rollers and depress the out-of-paper switch. I'm also careful that all of the sticky part is attached to the paper so the Post-Its don't get stuck in the printer.

Robert LaFara
Indianapolis, Indiana

▶**PC MAGAZINE:** Chalk up one more use for those indispensable yellow pads! This is the most elegant and simple solution I've ever encountered. I used to disable the paper-sensing switches in my dot matrix printers permanently by plastering them down with sticky mailing labels. I've also tried all sorts of page-carrier devices, but they always caused slippage and misalignment.

Fortunately, most modern dot matrix printers either include a cut-sheet feeder or have one available as an option. But

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See index, page 347.

you'll probably still need to resort to this Post-It solution when using card stock, which is stiffer than most sheet feeders can handle.

Laser-printer users may be interested in another variation: I use Post-Its to hold small pieces of paper—such as bank deposit slips—in place on regular letter-size sheets of paper for printing. For best results, use the straightest paper path your printer offers, such as manual feed and face-up output on an HP LaserJet Series II or other printer based on a Canon SX engine.—*Alfred Poor*

Operating Environments

USING THE SUBST COMMAND

❓ I'm running DOS 5.0 and having trouble getting the SUBST command to work. Though I've included the line `LASTDRIVE=Z:` in my CONFIG.SYS file, if I give the command `SUBST M: C:\`, I get the message "Path not found—C:\". What's wrong, and how can I fix it?

Richard E. Mild
Wichita, Kansas

▶**PC MAGAZINE:** I suspect that the example you cite is not the actual command you tried to use. The SUBST command turns out to be quite finicky about how you use trailing backslashes when you name a directory. For example, `SUBST M: C:` will produce an error message: "Invalid parameter—C:". But `SUBST M: C:\` will work just fine.

If you try `SUBST M: C:\TEMP\`, however, you get "Path not found—C:\TEMP\"—even if there is a TEMP directory off your disk's root directory. You have to state it as `SUBST M: C:\TEMP` in order to get the command to work. The trick is to use a trailing backslash *only* if you are referring to the root directory; otherwise, leave it off.

You may have heard warnings against using the SUBST command if you're running Windows, but as long as you're careful to establish the substitution before you start Windows, you shouldn't have any problems. You should never add or change a SUBST assignment during a Windows session, however.

Our Advisors

Douglas Boling is a contributing editor and the author of many utilities, including MBOOT.COM and EMS40.SYS.
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Neil J. Rubenking is technical editor and the author of two Turbo Pascal books and *PC Magazine DOS Batch File Lab Notes.*
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Craig Stinson is a contributing editor and coauthor of *Running Windows 3.1* and *Running Microsoft Excel.*
M. David Stone is a contributing editor and coauthor of *Word for Windows Companion,* Second Edition.
Ethan Winer is a contributing editor and the author of *PC Magazine BASIC Techniques and Utilities.*

I've included a SUBST statement in my AUTOEXEC.BAT that substitutes a drive letter for a directory that is three levels down from the root directory, which in turn has a dozen or so subdirectories below it. This use of the SUBST command saves a lot of typing and scrolling through directory boxes, and I've never had a problem with this configuration under Windows 3.0 or 3.1.

Beginning with DOS 4.0, there's a hidden goodie you should know about if you use SUBST: the TRUENAME command, which tells you what the "real" path is for a substituted drive. For example, in order to see the path for drive M:, all you have to do is give the command `TRUENAME M:` and DOS will display the full path. (If you are currently in a subdirectory of drive M:, such as M:\TEMP, the subdirectory will be included as part of the path.) This undocumented DOS command is a real boon to users who take advantage of the SUBST command. —*Alfred Poor*

CD-ROMS FOR OS/2

❓ I have an 80486 PC running OS/2 2.0. Can you tell me what I have to do to add a CD-ROM drive? OS/2 shipped with a standard CD-ROM driver (CDROM .SYS). Will this driver support any CD-ROM I can buy, such as those from NEC,

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Talon, and Texel? And what about SCSI or proprietary adapters from drive manufacturers?

P. Barthe
New York, New York

▶PC MAGAZINE: The CDROM.SYS driver that shipped with the original release of OS/2 2.0 supported only IBM and Toshiba CD-ROM drives and a limited number of SCSI cards. IBM later released a generic SCSI CD-ROM driver that was supposed to work with CD-ROMs from other vendors, but most users quickly discovered that getting their CD-ROM to work with this driver was a hit-or-miss proposition.

OS/2 2.1 has changed all that. IBM responded to customer complaints about OS/2's limited CD-ROM support by adding direct support for more than 31 different CD-ROMs, including various models from Hitachi, NEC Technologies, Panasonic Communications & Systems Co., Pioneer, Sony, Texel, and Toshiba America Information Systems. Support for various SCSI cards from Adaptec, DPT, Future Domain Corp., and IBM has also been added. IBM released OS/2 2.1 on June 14; upgrades from previous versions remain free.—*Joe Salemi*

Word Processing

SLIM DOWN WINWORD FILES CONTAINING GRAPHICS

❓ I recently had a chance to use Microsoft Word for Windows 2.0 for the first time and liked it enough that I almost decided to use it for my next book. After working with it for several days, however, I realized that if you add graphics to a file, the program eats up a surprising amount of disk space.

For example, I started by importing a 32,768-byte ASCII text file into WinWord, and then embedded two PCX graphics files, each of which was roughly 12,500 bytes. The resulting file, saved as a WinWord document file, was nearly 93,000 bytes. Following the same procedure with Windows 3.1 Write yielded a file that was only about 51,000 bytes. Given this difference, WinWord would seem to be a poor choice if you need to include graphics in your documents. Is there any way to minimize the WinWord document file size?

Sumpun Wongnawa
Hat Yai, Songkla, Thailand

▶PC MAGAZINE: The amount of disk space WinWord uses for graphics varies greatly depending on how you insert the graphics into your document. (I'm using *insert* in its generic sense here and am not referring only to the choices on the WinWord Insert menu.) To prove the point, I started with a 32,496-byte PCX file, inserted it into an otherwise empty WinWord document using two different techniques, and then modified it in various ways.

For each technique, and each modification, I created and saved a new file. As a point of reference, I also inserted the graphic into Write by copying it from

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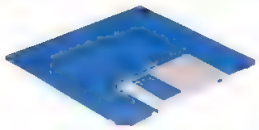

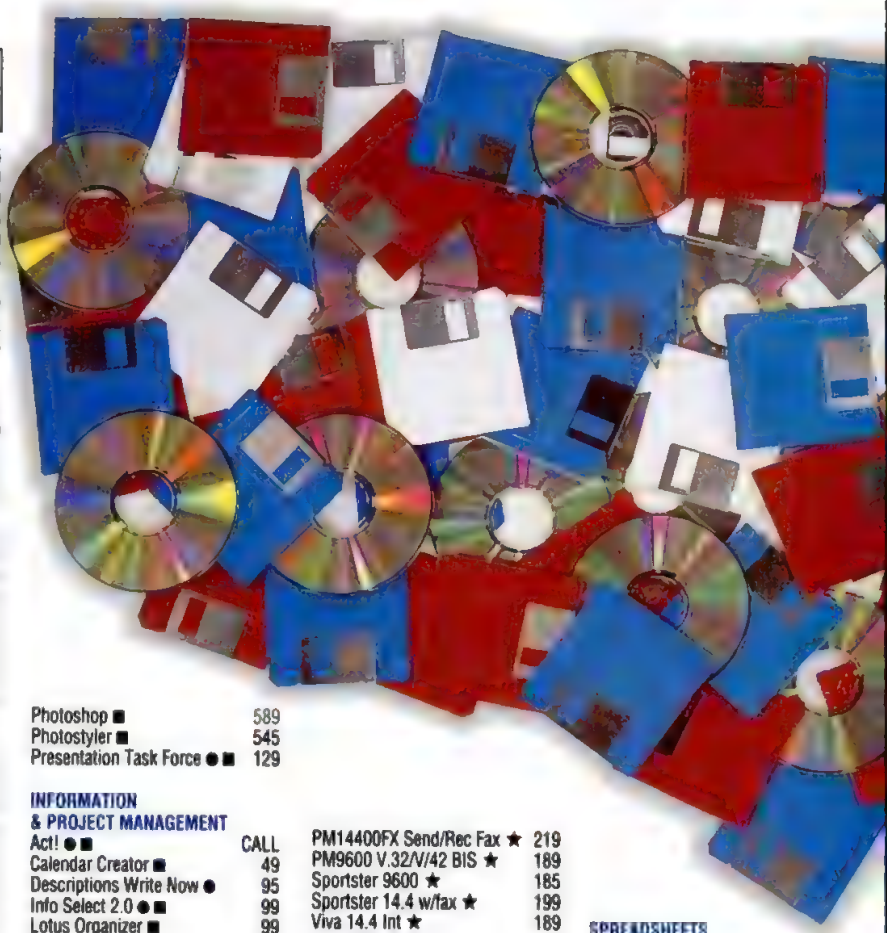

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File Sizes When a Graphic Is Inserted

Image-insertion method	Resulting field	Size (bytes)
Original PCX file	None	32,496
Write file, inserted with Copy from Paintbrush, Paste into Write	None	308,352
WinWord file, inserted with Copy from Paintbrush, Paste into WinWord...	EMBED (Paintbrush)	927,230
...then Ctrl-Shift-F9 to break link...	None	311,276
...then edit as MS-Draw object	EMBED (MS-Draw)	930,401
Insert Picture...	None	156,728
...then edit as MS-Draw object...	EMBED (MS-Draw)	466,017
...then Ctrl-Shift-F9 to break link	None	157,263

Figure 1: **As these samples show, the file size of a WinWord document that includes graphics can vary tremendously, depending on how the graphics are inserted. In general, graphics inserted as actual images yield smaller files than graphics inserted as field code results.**

Paintbrush to the Clipboard and pasting it into Write. Figure 1 shows the results of these tests.

The largest file by far was 927,230 bytes, created by loading the graphic in Paintbrush, copying it to the Clipboard, and then pasting it into WinWord. The result is automatically entered as an EMBED field, with Paintbrush as the server application—meaning that if you chose to edit the image (by double-clicking on it or choosing Edit | Paintbrush Picture Object), Windows would load Paintbrush to let you modify the file. The graphic image is the result returned by the EMBED field code.

At 927,230 bytes, the WinWord file is three times the size of the Write file created the same way. But if you select the object in WinWord, and then type Ctrl-Shift-F9 to break the link, WinWord will replace the EMBED field with the picture itself—no longer a field code—and the file size will drop down to 311,276 bytes, or about the same size as the file in Write. If you then edit the graphic in Microsoft Draw by double-clicking on it or selecting it and choosing Edit | Picture, WinWord will replace the image with another EMBED field, this time using MS-Draw as the server application. The resulting file size will balloon back up to 930,401 bytes.

The smallest WinWord file size I arrived at was 156,728 bytes, created by inserting the graphic with the Insert | Picture command. By default, Insert | Picture inserts the picture itself rather than a field code. But if you edit the image with MS-Draw, thereby converting the graphic to an EMBED field, the file size jumps to 466,017 bytes. Break the link and it falls back to roughly the original size.

In both of these test runs, regardless of how I originally inserted the graphic, the version with the graphic image itself was about one third the size of the version with the EMBED field. According to Microsoft, similar ratios generally hold true for most graphic formats. The difference in file size between the two techniques is based on how you insert the image into the document.

If you want to minimize file size, then, you'll want to use Insert | Picture rather than pasting from the Clipboard. And you'll want to avoid using EMBED fields, converting the fields to actual images instead. But be careful not to break a link unless either you're sure you won't need to edit the graphic again or you can edit it in MS-Draw.

If you really want to cut file sizes down to the absolute minimum, there's another option that you should be aware of. The PSS.DOC file that comes with WinWord 2.0c offers a macro that will allow you to store graphics as external files—a trick that will cut down on file size drastically. The single macro LoadSavePictures replaces the Save Small and LoadSmall macros that come with Version 2.0a and 2.0b. (Note that you can upgrade to Version 2.0c from 2.0 or later for no charge simply by calling Microsoft customer service at 800-426-9400.)

To install the macro, open PSS.DOC. (If you chose a full install when you originally installed WinWord, you should be able to find the file in your WinWord program directory.) Browse through the list of macros until you find the Install macro, and double-click on its RUN macro button.

The Install macro will show you a message box. Choose OK. Then, in the dialog box that follows, highlight LoadSavePictures in the list box on the left and accept Normal as the template to install to, in the list box on the right. Then choose OK. If you don't already have a NORMAL.DOT template, the macro will ask if you want to create one. Answer Yes, then Yes again to save the global glossary and command changes. The next dialog box gives you the option to designate a menu and shortcut key for the LoadSavePictures macro. The Install macro takes care of everything else.

LoadSavePictures works only with graphics inserted with an IMPORT field. (WinWord automatically creates an Import field if you use Insert | Picture and check the Link To File check box.) To use it, run LoadSavePictures before saving a file and choose the Compress button in its Linking Pictures dialog box. When you do this, the macro finds all

File Sizes When Using LoadSavePictures

Image-insertion method	Resulting field	Size (bytes)
Insert Picture with Link...	Import	156,389
...then compress with LoadSavePictures and save...	Import	2,271
...then restore with LoadSavePictures and save...	Import	156,389
...then edit as MS-Draw object and save	Embed (MS-Draw)	465,656

Figure 2: **The LoadSavePictures macro will let you cut down tremendously on file size when inserting graphics. But it only works on graphics inserted as pictures linked to a file. If you edit the graphic with MS-Draw so that WinWord changes it to an embedded field, the macro will no longer have any effect.**

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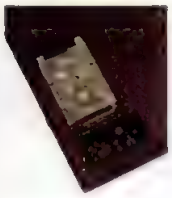

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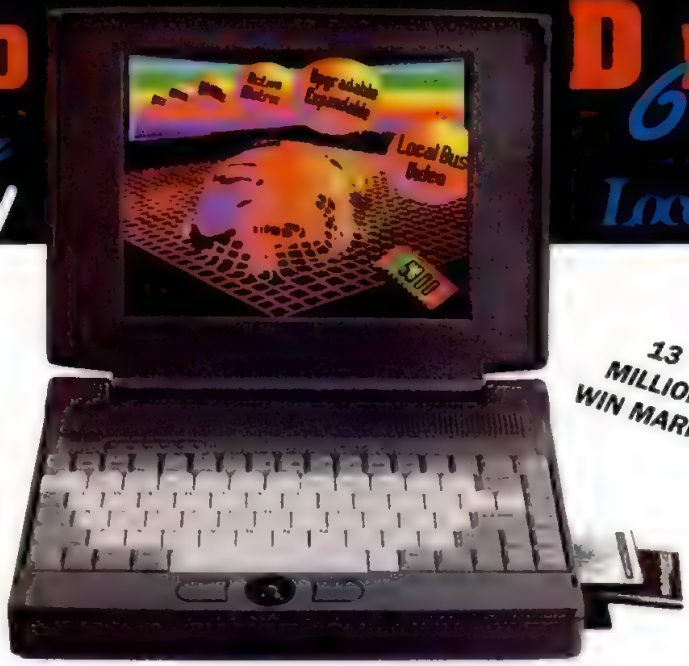

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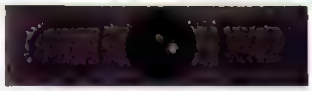

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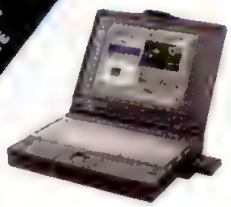

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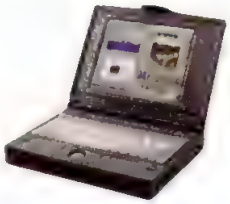

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IMPORT fields in the file and modifies them so that they can no longer import a graphic.

As shown in Figure 2, if you save a file after running the macro, you wind up with a considerably smaller file—2,271 bytes compared with the 156,389 bytes just for inserting the PCX test file. Of course, you still need the original PCX file on-disk, but the PCX file for these examples is only 32,496 bytes, so the total disk space required is still far less than when you insert the graphic image itself without a field.

To change the IMPORT fields back to their original form, you can reopen the file, run the macro again, and choose the Restore button on the macro dialog box. Or you can load the file and restore the graphics in a single step by running the macro and choosing its Open button.

Note too that if you start with a graphic that's placed in a document as an IMPORT field, and then edit it with MS-Draw, WinWord will convert the result to an EMBED field. You can then break the link to MS-Draw with Ctrl-Shift-F9, but the LoadSavePictures macro will no longer have any effect on that graphic.

Another choice is to modify the external file with a program other than MS-Draw—such as Paintbrush. This way, the IMPORT field will import the modified version the next time you run LoadSavePictures or otherwise update the field.
—M. David Stone

Spreadsheets

EXTERNALIZED LOOKUP TABLES IN 1-2-3

TIP Having recently discovered the power of 1-2-3's @VLOOKUP function, I set about creating applications in which a part number is entered on a worksheet and a corresponding unique description is "looked up" and entered into an adjacent cell. Things were going great until the list of part numbers began to grow and the "unique" descriptions started undergoing frequent modifications. Then the lookup applications themselves began to proliferate, and I found myself recreating the parts list in lots of different worksheets.

To cope with all this disarray, I decided to put the lookup table in a single external worksheet and then reference this external sheet from within my lookup applications. I call the external sheet MASTER.WK1. Then, in each of my lookup worksheets, I duplicate the table with linking formulas.

For example, if my table occupies the range A1..B1000 in MASTER.WK1, I start by putting the formula +<<MASTER.WK1>>A1 in cell A1 of my first lookup worksheet. Still in the lookup sheet, I copy A1's formula into A2..A1000 and B1..B1000. Then, elsewhere in the same sheet, I can write @VLOOKUP formulas that get the correct values from the lookup table.

Because cells A1..B1000 of my lookup worksheets always match the same range in my external worksheet, whenever the parts list grows or changes, I only need to modify it in one place. All the referencing worksheets are automatically updated.

Andrew Doherty
Rye, New Hampshire

▶PC MAGAZINE: Anytime you find yourself making use of the same data in multiple worksheets, it's a good idea to "externalize" that data. Even if the data resides in a spreadsheet file, think of that file as a database. Let your spreadsheet do what it does best—analyze and present—and keep the data out on-disk. Along with the efficiencies mentioned in Mr. Doherty's letter, this approach gives you better security. To protect against accidental or mischievous changes, for example, you can password-protect the data file or assign it read-only status.

The first step in Mr. Doherty's lookup procedure—copying the complete table into the lookup worksheet—is necessary only in the Release 2 variants of 1-2-3. In 1-2-3, Release 3.*x*, or 1-2-3 for Windows, you can eliminate this step and simply supply an external file reference as the table argument of the lookup formula. For example, in 1-2-3 for Windows, your formula might look like this:

```
@VLOOKUP(8,<<\123\DATA\MASTER.WK3>>
A:A1..A:B100,1)
```

This formula would behave exactly like any other @VLOOKUP formula, except that it would use an external range—A1..B100 in the worksheet \123\DATA\MASTER.WK3—as the lookup table.
—Craig Stinson

NAMING NAMES

TIP I enjoy reading the Solutions column and am always pleased to find Excel macros in the Spreadsheets section. The EMBOSS .XLM macro in the April 13, 1993, issue caught my attention, so I tried it out. In doing so, I discovered some problems.

It seems that you overlooked a basic rule of Excel—namely, do not use names in a document that duplicate function names. The names `Result` and `Effect` violate this rule, and while the name `Result` appears to have no negative effects, the name `Effect` does—if you have the Analysis ToolPak add-in macro installed. In fact, you can't even type in the statement

```
=if(Effect=1)
```

in cell B11 without the name `Effect` changing to the function EFFECT when you press the Enter key. The net result is that you can never "recess" a selection, because the IF statement in B11 is never true. This can be remedied by choosing another name such as `Effects` and changing all references to that name.

As for the name `Result`, it too should be changed. Even though the macro seems to work using that name, I would not be surprised if someone had problems with it.

Steve Luckey
Saraland, Alabama

▶PC MAGAZINE: Mr. Luckey is right that you should avoid assigning the names of functions to cells, ranges, values, and whatnot. With spreadsheet programs' function libraries growing richer every year, this rule is getting harder to observe. I admit to having never used the EFFECT() function and thus having overlooked the name duplication.

On the other hand, the difficulty that Mr. Luckey encountered in recreating Scott Webb's Emboss macro is itself the

consequence of a design peculiarity in Excel 4.0. Excel is supposed to tolerate the application of function names to worksheet and macro-sheet cells, provided that those names don't include parentheses. And if you define the name `Effect` on your macro sheet before typing in any of the macro code, you won't experience the problem described by Mr. Luckey. (Mr. Webb evidently built his macro this way.)

But Excel 4.0 is also programmed to watch vigilantly for the names of Microsoft-supplied add-in functions and to run out to disk and grab the appropriate .XLA file the moment it sees one of those names. If you type `=Effect` on a macro sheet without having first defined `Effect` as a name, Excel will immediately load the add-in macro ANALYSF.XLA and will assume you're referring to the function `EFFECT()`. The same thing happens if you type an equal sign followed by the name of one of the functions in ADDINFNS.XLA, such as `randbetween`. What's peculiar here is that the disk fetch occurs even if all you type is the keyword, without the parentheses.

The reason the name `Result` did not create a problem for Mr. Luckey is that the RESULT() function is built into the EXCEL.EXE file, rather than being part of an add-in macro. You can use names such as `Sum`, `Max`, and `Result` wherever you like without sending Excel to disk or damaging your macro code. On the other hand, as Mr. Luckey observes, such a practice is bad form and liable to get you into trouble.—*Craig Stinson*

Databases

DESIGN PAL DIALOGS USING PAINTPAL

▶**PC MAGAZINE:** Paradox 4.0 introduced a new event-driven user interface model that lets you design and use dialog boxes in your PAL applications. A dialog box, as you may already know, is a type of window that can be used to solicit information from the user. It contains controls—objects that a user can manipulate, such as push buttons and check boxes.

To create a custom dialog box, you place the PAL SHOWDIALOG command in your PAL script. A simple example follows:

```
SHOWDIALOG "Dialog Example"
   @2,23 HEIGHT 6 WIDTH 32

   PUSHBUTTON @1,12 WIDTH 6
      "Ok"
      VALUE "Ok"
      TAG "OkButton"
      TO cOkButton
ENDDIALOG
```

This example displays a dialog box that contains a single push button. Let's take a moment to examine this SHOWDIALOG command. You can probably guess how Paradox interprets the first three lines. First, a dialog window titled "Dialog Example" is opened at row 2, column 23. The dialog is 6 rows high and 32 columns wide. Next, a 6-character-wide push button is created inside the dialog window at row 1, column 12. The line that follows PUSHBUTTON specifies the text to appear on the push button—in this case "Ok".

The VALUE keyword specifies the value to assign to a variable when the push button is pressed. The variable that receives the value is named using the TO keyword; in this case, the variable is named `cOkButton`. In our example, when the push button is pressed, the text string "Ok" is assigned to `cOkButton`.

The TAG keyword assigns a name to the push-button control. The TAG name is passed as a parameter to certain PAL commands and functions and to dialog-box procedures. A dialog-box procedure is a special procedure you write that Paradox will call when certain events occur during dialog-box processing. You specify the name of the dialog-box procedure and the events that will trigger the procedure. When the procedure is called, Paradox passes it the TAG name of the active control.

Finally, the ENDDIALOG command denotes the end of the dialog-box definition.

The SHOWDIALOG command lets you create push buttons, pick lists, radio buttons, check boxes, type-in boxes, and sliders, in addition to labels, static text, boxes, and painted regions. Each control requires a statement similar to the one shown above for PUSHBUTTON, though the number and type of keywords differ, depending on which control you're specifying.

If your dialog box calls for the use of many controls, writing the required control statements can involve a great deal of tedious detail. It's quite difficult to get the placement, color, and size of the dialog-box controls exactly the way you want them without seeing what the dialog-box elements look like on-screen. You'll find yourself modifying the SHOWDIALOG code, running it to see whether the dialog looks right, modifying it again, checking again, and on and on. This can be frustrating because just changing the code to experiment with positioning the controls in different ways can take quite a lot of time.

Unfortunately, relief from this tedious and time-consuming process is not available from within Paradox itself. When the folks at Borland International updated Paradox to support SHOWDIALOG, they did not include any corresponding support for dialog-box design. The form designer, for example, does not support the new dialog-box features.

This means that when using Paradox out of the box, you must manually adjust SHOWDIALOG statements. But fortunately there's another option. PaintPAL, a third-party product from Target Software in Allentown, Pa., is an excellent

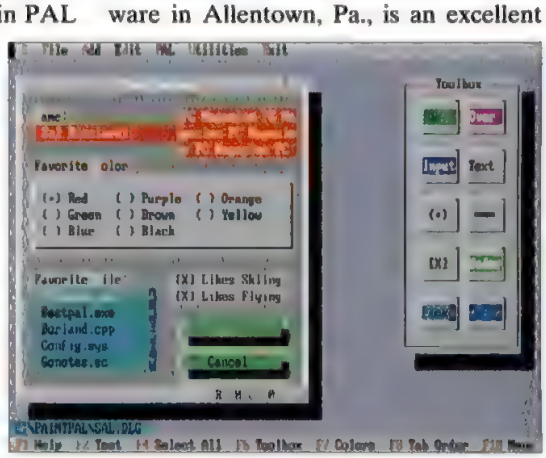

Figure 3: **PaintPAL lets you draw your PAL dialog boxes on-screen using its suite of toolbox tools, and then lets you generate the appropriate SHOWDIALOG code.**

Windows at Your Fingertips

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PC MAGAZINE, June 29, 1993, First Looks

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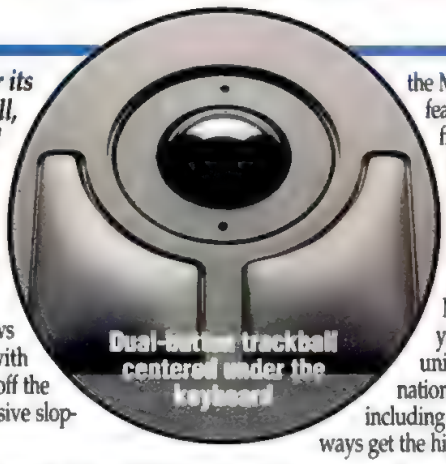
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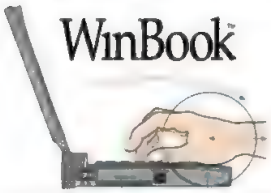

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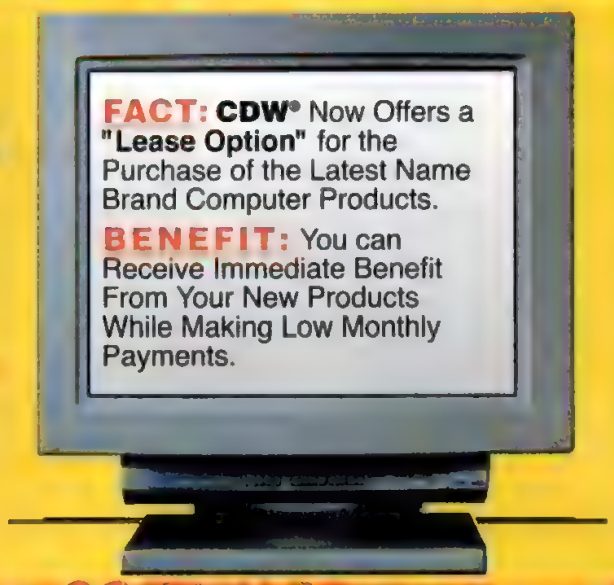

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standalone PAL dialog-box designer that supports SHOWDIALOG. Using PaintPAL, you can paint your dialog-box design on-screen and then let it generate the SHOWDIALOG code for you.

PaintPAL uses a Turbo Vision–style user interface and is easy to use. You design the dialog box in a window and choose menu items from drop-down menus. A floating toolbar (shown in Figure 3) lets you click and drag controls onto your dialog box, where you can resize them by dragging on the lower-right-hand corner of the control with the mouse. PaintPAL supports all of the controls, which can be chosen from a drop-down menu as well as from the toolbar.

To specify an object's properties, such as its variable name, tag name, and other required information, you simply click the right mouse button over the object. A dialog appears that lets you fill in the options.

Once you've placed all of the objects in your dialog, you can activate a test mode to test the dialog's design from within PaintPAL. This lets you see the dialog as it will appear within Paradox and allows you to interact with the controls as your application's user would. You can also verify and change the tab order—the order in which the cursor moves from field to field.

PaintPAL can "validate" your design. That is, it can make sure that you've specified all the required properties needed to generate correct PAL code. This means you can quickly place a bunch of controls on a dialog design and test it, without having to first specify all of the properties. Later, you can use the validate feature to help you go back and fill in the properties.

PaintPAL saves your dialog design in a special binary file that has a .DLG file extension (you can place the design in a Paradox BLOB field if you like). When you generate PAL code, you can choose to send the code to a new file, an existing file, the screen, the Paradox editor, or one of two popular third-party editors for PAL programmers: PAL-Edit from Kallista or Playright Pro from PAL By Example. If you choose to send the code to an existing file, PaintPAL will automatically find and replace the existing dialog-box code in the file with your new dialog code. It can do this because it assigns a unique identifier to each dialog box; it uses this identifier to find the previous version of the code you want to replace.

Most design tools that generate source code suffer from "one-way" syndrome. You can generate source code from a design, but you cannot generate a design from source code. This means you cannot edit the generated source code directly because generating a new version with the design tool overwrites the changes that you made directly to the code. Version 2.0 of PaintPAL, released in May, includes a remarkable feature: It can build dialog designs by reading your existing PAL source code and interpreting your SHOWDIALOG statements, whether they were created by PaintPAL or not. PaintPAL reads your source code and then presents a list of the dialogs it finds. You can then choose to import or merge one of these dialogs into your PaintPAL dialog. Because of this feature, you can make changes to the source code directly and then read it back into PaintPAL in order to create an updated dialog design. Version 2.0 also creates dialog-box designs directly from tables or from Paradox forms.

PaintPAL 2.0 can build dialog designs by reading your existing PAL source code and interpreting your SHOWDIALOG statements, whether or not they were created by PaintPAL.

The lack of a dialog designer in Paradox 4.0 is a glaring omission that will drive you crazy if you spend any time designing dialogs. Listing at $149, PaintPAL elegantly solves this problem. If you'd like more information, you can contact Target Software at 215-820-9918 (Hamilton Financial Center, One Center Square, #403, Allentown, PA 18101).
—*Sal Ricciardi*

Graphics

CREATING BLEEDS

❷ I often use PageMaker 4.0 to create designs that place a photograph or a tint right up to or off the edge of the paper. When I print to my laser printer, though, I get a white band that surrounds the entire page. Is there any way—on my printer—to produce accurate proofs that show bleeds?

Mary Callahan
Chicago, Illinois

▶**PC MAGAZINE:** The problem you describe occurs due to a mechanical limitation found in all printers. Any such device—be it a laser printer, Linotronic imagesetter, or commercial press—must reserve a portion of the page to grip the paper and feed it through the mechanism. The white band you see around the edge of your page is simply this area, called the nonprinting margin.

Every laser printer has a slightly different nonprinting margin, but, luckily, there's an easy way to determine the safety needed for your particular printer. First, start a new publication in PageMaker. Make sure that the page size is exactly the same size as the paper in your printer; so if you're using letter-size paper, choose the corresponding 8.5- by 11-inch page size. Now use the rectangle tool to draw a box that covers the entire page. Use the Element menu to fill the box with some printable tint or color (any choice other than None or Paper). When you print the page, you'll see that familiar white area around the edge of the paper. Now whenever you plan a publication, be sure to create page margins that are at least as wide as these nonprinting margins.

While this approach guarantees you accurate proofs, it means that you can never bleed an element off the edge of the paper. (For those unfamiliar with this term: To create a bleed, you must print an image so that it extends past the crop marks that define a page. Although it gets printed, the excess image is cut off when the page is trimmed, making it look as if the image has been positioned precisely on the edge of the paper.)

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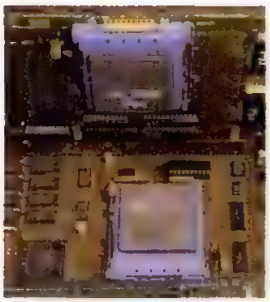

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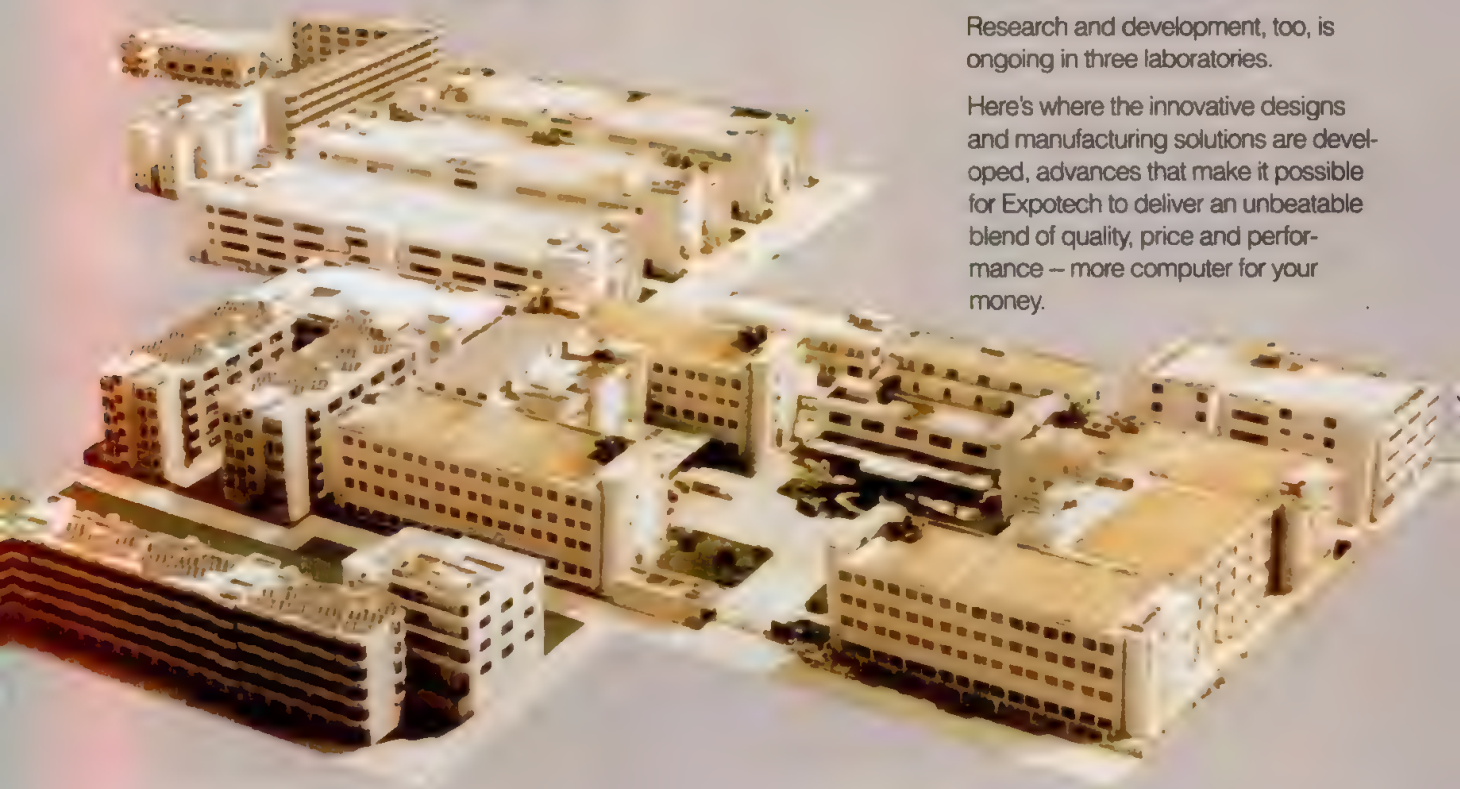

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Networking

RUNNING LANTASTIC 5.0 WITH A XIRCOM ADAPTER

❓ I manage a 10-node LANtastic network that we recently upgraded from Version 4.0 to Version 5.0. I'd like to connect several salespeople who use laptop computers to the network.

I purchased a Xircom Pocket EtherNet Adapter because I was told that Xircom had drivers for LANtastic. They do—but only for Version 4.1. Xircom does not support Version 4.0, and it doesn't expect to support LANtastic 5.0 for several months. I can't even purchase Version 4.1 from Artisoft; they no longer sell it. What can I do?

Chan Martin
Chattanooga, Tennessee

▶PC MAGAZINE: There are two ways to solve your problem. You can purchase Artisoft's NDIS Support for LANtastic at $199 per network. NDIS Support for LANtastic will allow you to use any network adapter card that supports NDIS (Network Driver Interface Specification). The Artisoft product includes drivers for the Xircom Pocket Ethernet Adapter as well as many other network adapters.

The second option is less expensive, but not as slick. You can obtain the LANtastic 4.1 NetBIOS drivers from the Artisoft Forum on CompuServe. From the Drivers library, download AEX41.ZIP and PE2AI.ZIP. AEX41.ZIP contains the LANtastic 4.1 NetBIOS drivers for your Artisoft cards, and PE2AI.ZIP includes the LANtastic 4.1 drivers for the Xircom adapter.

After you have these files, you'll need to load the LANtastic 4.1 versions of AEX and AILANBIO on every desktop PC on your network and PE2AI and AILANBIO on your laptops. You can still use LANtastic 5.0 network files such as REDIR and SERVER, but each machine must use the 4.1 LAN adapter drivers. The NetBIOS differs among the different versions of LANtastic, and they are not compatible. So the solution is to run LANtastic 5.0 with Version 4.1 NetBIOS drivers. This is a patch, but it works fine.—*Frank J. Derfler, Jr.*

DIAL-ON-DEMAND ROUTERS

❓ In your article on using high-speed circuits to link LANs ("Making the WAN Connection: Linking LANs," March 16, 1993) you described routers that can dial up connections on an "as-needed" basis. Who makes those devices?

Paul Zyr
Elizabeth City, North Carolina

▶PC MAGAZINE: Many companies make routers that will automatically use switched digital services as a backup for a full-period leased line. If the leased line fails, these devices make a call to restore the connection using Switched 56 or even Switched T1 services. But the capability you're asking about is more complex.

Cisco Systems offers a line of routers with what it calls Dial-on-Demand Routing (DDR). When their internal programming tells them that they have traffic addressed to nodes on specific distant networks, these routers use the CCITT V.25bis protocol to control the data communications equipment that places the switched digital call. CCITT V.25bis is a standardized set of commands that operates like the well-known set of AT modem control commands. While you wouldn't use this kind of switched connection on links that pass traffic 24 hours a day, dialed-up links can be practical for connections that will last for several hours. Typical apps include e-mail updates, bulk data transfers, and operations in widely separated time zones.
—*Frank J. Derfler, Jr.*

Languages

ALLOCATING EXTENDED MEMORY

TIP I recently needed to access more memory under Turbo Pascal than was available by defining a static array or allocating one on the heap. Since I have several megabytes of extended memory, I wrote the unit XMS.PAS (Figure 4) to provide access to extended memory. For the routines to work, HIMEM.SYS—the extended memory driver that comes with either DOS or Windows—must be loaded. You must run the unit on a 286 or 386 machine equipped with more than 1MB of memory.

The seven Turbo Pascal functions in the program are commented and are self-explanatory. I've also supplied a sample test program, XMSTEST.PAS (Figure 5), that does the following:

- Verifies that the extended memory driver HIMEM.SYS is loaded.
- Displays the total extended memory.
- Displays the largest free extended memory block.
- Allocates an extended memory block of 512K to hold 131,072 long integers at 4 bytes each.
- Displays the memory handle returned.
- Displays the extended memory available after the 512K has been allocated.
- Fills the 512K extended memory area with the numbers 1 through 131,072.
- Reads and displays the first and last element in the 512K extended memory area just to show how it's done.
- Frees the 512K extended memory block using the handle returned when it was allocated.

Special thanks to Ray Duncan and chapter three of his excellent book "Ex-

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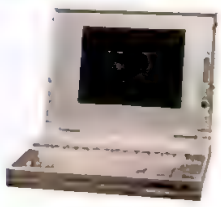

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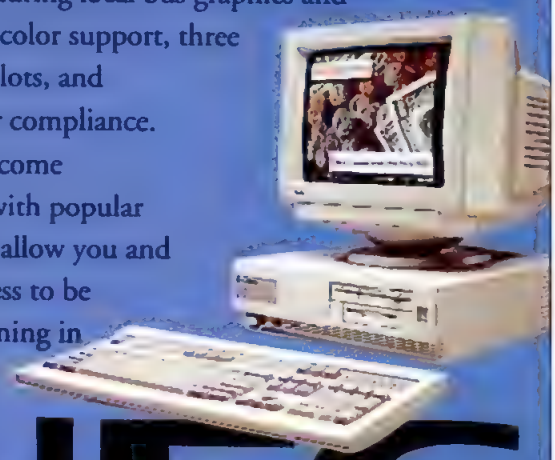

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IBM	11,525
Zeos	15,067
The Rest	14,000

Sources: PC MAG & Computer Shopper review for Jan. July 1993. Compaq ProLinea has no external cache.

Comtrade 486 systems have the competition running for cover. In review after review, critic's applaud Comtrade's shocking speed and extraordinary value. In three separate reviews (Computer Shopper, PC Sources, and Windows Sources), editors have unanimously chosen Comtrade systems for top honors in both System and Windows Graphics Performance. Also in Byte Magazine's review (June 93), Comtrade again ranked #1 for Windows Performance out of 116 systems reviewed. "Comtrade Processor Outpaced All The Others," say Windows Sources (June 93). If you work in Windows, Comtrade 486 will be love at first sight.

A Processor Harmonic score of 17,493 was good for top honors in this group - Computer Shopper, Feb 1993.

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XMS.PAS


```
{———— Extended Memory Access Unit ————}
UNIT XMS;
{**} INTERFACE {**}
VAR
  XMSErrorCode : byte;      { Error Code - Defined in XMS Spec }
  XMSAddr      : Pointer;   { Entry Point for HIMEM.SYS Driver }

FUNCTION XMSDriverLoaded: Boolean;
FUNCTION XMSTotalMemoryAvailable: Word;
FUNCTION XMSLargestBlockAvailable: Word;
FUNCTION XMSAllocateBlock(KBSize: Word): Word;
FUNCTION XMSReleaseBlock(Handle: Word): Boolean;
FUNCTION XMSMoveDataTo(SourceAddr: Pointer; NumBytes: LongInt;
          XMSHandle: Word; XMSOffset: LongInt): Boolean;
FUNCTION XMSGetDataFrom(XMSHandle: Word; XMSOffset: LongInt;
          NumBytes: LongInt; LowMemAddr: Pointer): Boolean;

{**} IMPLEMENTATION {**}

TYPE
  XMSMoveStruct = record
    movelen   : LongInt;   { length of block to move in bytes }
    case integer of
      { Case 0 Variant for Low Memory to XMS }
      0: (SHandle   : Word;       { source handle = 0
                                    for conventional memory }
          SPtr      : pointer;    { source address }
          XMSHdl    : Word;       { XMS destination handle }
          XMSOffset : LongInt);   { 32 bit XMS offset }
      { Case 1 Variant for XMS to Low Memory }
      1: (XMSH      : Word;       { XMS source handle }
          XMSOfs    : LongInt;    { starting offset in XMS}
          DHandle   : Word;       { 0 when conventional memory
                                    destination }
          DPtr      : pointer);   { address in conventional memory }
    END;

VAR moveparms : XMSMoveStruct;    { structure for moving to and
                                    from XMS }

{*********************************************************}
{ XMSDriverLoaded - Returns true IF Extended Memory Driver     }
{                   HIMEM.SYS Loaded                           }
{                 - Sets Entry Point Address - XMSAddr         }
{*********************************************************}
FUNCTION XMSDriverLoaded: Boolean;
CONST
  himemseg: Word = 0;
  himemofs: Word = 0;
BEGIN
  XMSErrorCode := 0;
  ASM
    mov ax,4300h       { Check to see IF HIMEM.SYS installed }
    int 2fh
    cmp al,80h         { Returns AL = 80H IF installed }
    jne @1
    mov ax,4310h       { Now get the entry point }
    int 2fh
    mov himemofs,bx
    mov himemseg,es
  @1:
  END;
  XMSDriverLoaded := (himemseg <> 0);
  XMSAddr := Ptr(himemseg,himemofs);
END;

{*********************************************************}
{ XMSTotalMemoryAvailable - Returns Total XMS Memory Available }
{*********************************************************}
FUNCTION XMSTotalMemoryAvailable: Word;
BEGIN
  XMSErrorCode := 0;
  XMSTotalMemoryAvailable := 0;
  IF XMSAddr = nil THEN        { Check IF HIMEM.SYS Loaded }
    IF NOT XMSDriverLoaded THEN exit;
  ASM
    mov  ah,8
    call XMSAddr
    or   ax,ax
    jnz  @1
    mov  XMSErrorCode,bl  { Set Error Code }
    xor  dx,dx
    @1:
    mov  @Result,dx       { DX = total free extended memory }
  END;
END;

{*********************************************************}
{ XMSLargestBlockAvailable - Returns Largest Contiguous        }
{                            XMS Block Available               }
{*********************************************************}
FUNCTION XMSLargestBlockAvailable: Word;
BEGIN
  XMSErrorCode := 0;
  XMSLargestBlockAvailable := 0;
  IF XMSAddr = nil THEN        { Check IF HIMEM.SYS Loaded }
    IF NOT XMSDriverLoaded THEN exit;
  ASM
    mov  ah,8
    call XMSAddr
    or   ax,ax
    jnz  @1
    mov  XMSErrorCode,bl { On Error, Set Error Code }
    @1:
    mov  @Result,ax      { AX=largest free XMS block }
  END;
END;

{*********************************************************}
{ XMSAllocateBlock - Allocates Block of XMS Memory             }
{                  - Input - KBSize: No of Kilobytes requested }
{                  - Returns Handle for memory IF successful   }
{*********************************************************}
FUNCTION XMSAllocateBlock(KBSize: Word): Word;
BEGIN
  XMSAllocateBlock := 0;
  XMSErrorCode := 0;
  IF XMSAddr = nil THEN { Check IF HIMEM.SYS Loaded }
    IF NOT XMSDriverLoaded THEN exit;
  ASM
    mov  ah,9
    mov  dx,KBSize
    call XMSAddr
    or   ax,ax
    jnz  @1
    mov  XMSErrorCode,bl { On Error, Set Error Code }
    xor  dx,dx
    @1:
    mov  @Result,dx      { DX = handle for extended memory }
  END;
END;

{*********************************************************}
{ XMSReleaseBlock - Releases Block of XMS Memory               }
{                 - Input:   Handle identifying memory to be   }
{                   released                                   }
{                 - Returns  true IF successful                }
{*********************************************************}
FUNCTION XMSReleaseBlock(Handle: Word): Boolean;
VAR OK : Word;
BEGIN
  XMSErrorCode := 0;
  XMSReleaseBlock := false;
  IF XMSAddr = nil THEN   { Check IF HIMEM.SYS Loaded }
    IF NOT XMSDriverLoaded THEN exit;
  ASM
    mov  ah,0Ah
    mov  dx,Handle
    call XMSAddr
    or   ax,ax
    jnz  @1
    mov  XMSErrorCode,bl  { On Error, Set Error Code }
    @1:
    mov  OK,ax
  END;
  XMSReleaseBlock := (OK <> 0);
END;

{*********************************************************}
{ XMSMoveDataTo - Moves Block of Data from Conventional        }
{                 Memory to XMS Memory                         }
{               - Data Must have been previously allocated     }
{               - Input - SourceAddr : address of data in      }
{                                      conventional memory     }
{                       - NumBytes   : number of bytes to move }
{                       - XMSHandle  : handle of XMS block     }
{                       - XMSOffset  : 32 bit destination      }
{                                      offset in XMS block     }
{               - Returns true IF completed successfully       }
{*********************************************************}
FUNCTION XMSMoveDataTo(SourceAddr: Pointer; NumBytes: LongInt;
          XMSHandle: Word; XMSOffset: LongInt): Boolean;
VAR Status     : Word;
BEGIN
  XMSErrorCode := 0;
  XMSMoveDataTo := false;
  IF XMSAddr = nil THEN  { Check IF HIMEM.SYS Loaded }
    IF NOT XMSDriverLoaded THEN exit;
  MoveParms.MoveLen    := NumBytes;
  MoveParms.SHandle    := 0;          { Source Handle=0 For
                                        Conventional Memory}
  MoveParms.SPtr       := SourceAddr;
  MoveParms.XMSHdl     := XMSHandle;
  MoveParms.XMSOffset  := XMSOffset;
```

Figure 4: **The functions in this Turbo Pascal 6.0 unit let you allocate and de-allocate chunks of extended memory for use as program data storage.**

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XMS.PAS

2 of 2

```
  ASM
    mov  ah,$Bh
    mov  si,offset MoveParms
    call XMSAddr
    mov  Status,ax        { Completion Status }
    or   ax,ax
    jnz  @1
    mov  XMSErrorCode,bl { Save Error Code }
    @1:
  END;
  XMSMoveDataTo := (Status <> 0);
END;

{*********************************************************}
{ XMSGetDataFrom - Moves Block From XMS to Conventional Memory }
{                - Data Must have been previously allocated    }
{                  and moved to XMS                            }
{              - Input - XMSHandle  : handle of source         }
{                                     XMS block                }
{                      - XMSOffset  : 32 bit source offset     }
{                                     in XMS block             }
{                      - NumBytes   : number of bytes to move  }
{                      - LowMemAddr : destination addr in      }
{                                     conventional memory      }
{              - Returns true IF completed successfully        }
{*********************************************************}
FUNCTION XMSGetDataFrom(XMSHandle: Word; XMSOffset: LongInt;
          NumBytes: LongInt; LowMemAddr: Pointer): Boolean;
VAR Status    : Word;
BEGIN
  XMSErrorCode := 0;
  XMSGetDataFrom := false;
  IF XMSAddr = nil THEN   { Check IF HIMEM.SYS Loaded }
    IF NOT XMSDriverLoaded THEN exit;
  MoveParms.MoveLen := NumBytes;  { Set-Up Structure to Pass }
  MoveParms.XMSh    := XMSHandle;
  MoveParms.XMSOfs  := XMSOffset;
  MoveParms.DHandle := 0;         { Dest Handle=0 For
                                    Conventional Memory}
  MoveParms.DPtr    := LowMemAddr;
  ASM
    mov  ah,$Bh
    mov  si,offset MoveParms
    call XMSAddr
    mov  Status,ax        { Completion Status }
    or   ax,ax
    jnz  @1
    mov  XMSErrorCode,bl { Set Error Code }
    @1:
  END;
  XMSGetDataFrom := (Status <> 0);
END;

BEGIN
  XMSAddr      := nil; { Initialize XMSAddr }
  XMSErrorCode := 0;
END.
```

XMSTEST.PAS

Complete Listing

```
{$X+}
Program XMSTest;
USES crt, XMS;
CONST
  NumVars     = 131072;   { 131072 total no of variables in array }
  BytesPerVar = 4;        { ie. 2 for integers, 4 for LongInts ...}
VAR
  I       : LongInt;
  Result  : LongInt;
  Hdl     : Word;          { Handle for Extended memory allocated }
  HiMemOK : boolean;
BEGIN
  ClrScr;
  HiMemOK := XMSDriverLoaded;
  WriteLn('HIMEM.SYS Driver Loaded=', HiMemOK);
  IF NOT HiMemOK THEN Halt;
  WriteLn('Total Extended Memory: ', XMSTotalMemoryAvailable, ' KB');
  WriteLn('Largest Free Extended Memory Block: ',
          XMSLargestBlockAvailable, ' KB');

  {Allocate Memory - Hdl is memory block handle or identifier}
  Hdl := XMSAllocateBlock((NumVars * BytesPerVar + 1023) DIV 1024);
         (1023 to Round Up to next KB)
  WriteLn((NumVars * BytesPerVar + 1023) DIV 1024,'KB Handle=',Hdl);
  WriteLn('Total Extended Memory Available After Allocation: ',
          XMSTotalMemoryAvailable, ' KB');

  { Fill the variables with 1 ... NumVars for exercise }
  WriteLn('Filling Memory Block ');
  FOR I := 1 TO NumVars DO
    BEGIN
      { parameters in Move Data are - Address of Data to Move
                                    - Number of Bytes
                                    - Memory Handle
                                    - Offset in XMS Area }
      IF NOT XMSMoveDataTo(@I, BytesPerVar, Hdl, (I - 1) *
        BytesPerVar) THEN
        WriteLn('Error on Move to XMS: ',I,' Error: ', XMSErrorCode);
      IF I MOD 1024 = 0 THEN Write(I:6,^M);
    END;
  WriteLn;
  { Now read a couple of locations just to show how}
  I := 1;  { First Element }
  IF NOT XMSGetDataFrom(Hdl, (I - 1) * BytesPerVar,
    BytesPerVar, @Result) THEN
    WriteLn('Error on XMSGetDataFrom')
    ELSE WriteLn('XMS Data [',I,']=',Result); { Print it }
  I := NumVars;  { Last Element }
  IF NOT XMSGetDataFrom(Hdl, (I - 1) * BytesPerVar, BytesPerVar,
    @Result) THEN
    WriteLn('Error on XMSGetDataFrom')
    ELSE WriteLn('XMS Data [',I,']=',Result); { Print it }

  WriteLn('Release status=', XMSReleaseBlock(Hdl));
  WriteLn('Press a key.');
  ReadKey;
END.
```

Figure 5: **This program exercises the XMS unit by allocating a 512K block of memory, moving 512K of data into it, and verifying that the data was correctly stored.**

tending DOS," which provided the necessary insight into using the extended memory driver HIMEM.SYS.

Allen M. Butler
Agoura, California

▶PC MAGAZINE: Even on my fast 486 machine, individually moving 131,072 Long Ints into extended memory took a *long* time—long enough that I wondered if the program had crashed. I added a line that writes the current value of variable I once for every 1,024 numbers so the program can clearly demonstrate that it's functioning. Interestingly enough, loading EMM386.EXE sped up the program by a *very* substantial margin.

HIMEM.SYS itself is not specifically required; another extended memory manager like QEMM.SYS will work fine. Running under QEMM.SYS, the program appeared even faster than when running under the combination of HIMEM.SYS and EMM386.EXE.

Turbo Pascal programs can't just allocate data structures on the XMS "heap" and access them like other dynamic structures; it's necessary to move the data into conventional memory when you want to use it. The best use for this XMS storage is for temporary program data that would otherwise have to be stored in a file.

You can download both of these programs from PC MagNet's Programming Forum archived as XMS.ZIP.

—*Neil J. Rubenking* □

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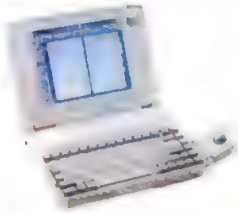

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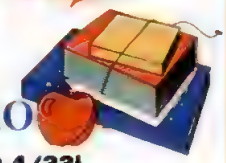

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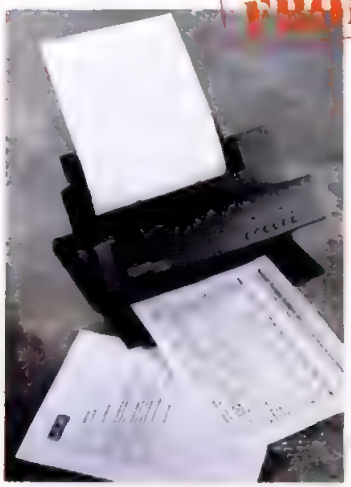

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C2614A

The HP DeskJet Portable Printer Features:
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- Up to 240 cps (10 cpi) in draft mode
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- Custom I/O cable included
- Custom carrying case can hold printer, optional cut-sheet feeder, your notebook PC, accessories, plus contents of a small briefcase
- Backed by HP reliability — one year limited warranty (worldwide)

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*Hewlett-Packard will send you a **$75 REBATE** on the DeskJet Portable Printer when purchased with one of the specially marked (*) accessories listed below. The printer and accessories must be purchased at the same time. Offer expires October 31, 1993.

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*Worldwide Battery Recharger *C3004A* ... $69.95
*50 Page Cut Sheet Feeder *C3005A* $69.95
*Carrying Case *C3050A* $69.95
Black Ink Cartridge *51633A* $17.95
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CIRCLE 051 ON READER SERVICE CARD

CODE # PM09B3

How a New Concept in Retailing Was Introduced in a Big Way.

Direct marketers offer convenience, low prices, customer service and technical support — for their own brands of PCs and laptops. Retailers offer a choice of leading brand names. What if you combined the best of both worlds?

Gordon Hoffstein, co-founder, *PCs Compleat*

That's what Gordon Hoffstein and his partners had in mind when they founded PCs Compleat in January 1992.

"We offer a broad selection of leading national brands *and* all the advantages of buying from a first-rate direct marketer.

"For example, when a buyer calls us about laptops, we can offer him thirty different choices. And he can discuss the standard and optional features offered by each manufacturer with a technically sophisticated salesperson who has all the facts. We do custom configurations and load applications and systems software. We ship the product out the same day, and we provide toll-free, lifetime technical support.

"When you have an idea this good, you don't want to be shy about it. That's why one of my first marketing decisions was to put a spread ad in every issue of PC Magazine, using the PC Direct section. And it's turned out to be our best lead generator by far.

"The PC Magazine reader is our ideal customer," he says. "PC Magazine brings us the kind of customers we want, those who know that value means more than just a low price.

"Because PC Magazine readers know about the products and features they want, they're ready to buy on the first call. They're also more interested in adding options like memory upgrades and fully loaded software. And they can communicate efficiently with our technical support people."

If you're a direct marketer with a breakthrough idea, bring it to the attention of over 1,000,000 of the most active and knowledgeable PC buyers. Call your PC Magazine sales representative or 212-503-5100 for the facts about PC Direct.

PC DIRECT

The Purchasing Source for Direct Buyers

BETTER FASTER CHEAPER

Western Digital Hard Drive
340MB, 3.5" IDE
$329
12ms 1" H

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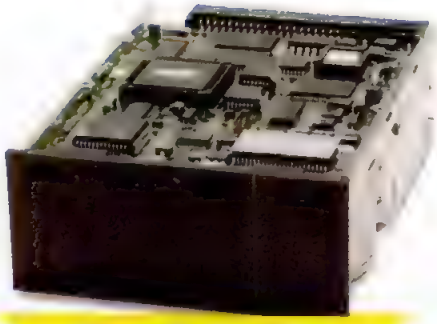

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40MB to 2.9 GIG!

Size	Access	Form Factor	Manufacturer	Interface	Model#	Bare Kit	16 Bit Kit
42MB	28ms	3.5" 1"H	Seagate	IDE	ST351A	$169	189
130MB	15ms	3.5" 1"H	Seagate	IDE	ST3144A	199	219
210MB	14ms	3.5" 1"H	Seagate	IDE	ST3243A	269	289
250MB	12ms	3.5" 1"H	Western Digital	IDE	WD225ØA	239	259
250MB	11ms	3.5" 1"H	Talon	IDE	TA3122A	289	309
250MB	12ms	3.5" 1"H	Conner	IDE	CP3Ø254	349	369
340MB	12ms	3.5" 1"H	Western Digital	IDE	WD234ØA	329	349
452MB	12ms	3.5" 1"H	Seagate	IDE/SCSI	ST355ØA/N	529/609	549/759
510MB	12ms	3.5" HH	Fujitsu	IDE	FJ2624A	699	719
520MB	12ms	3.5" HH	Fujitsu	SCSI	FJ2624S	699	849
540MB	12ms	3.5" 1"H	Seagate	IDE	ST3655A	649	669
1050MB	15ms	3.5" FH	Seagate	SCSI	ST112ØØN	999	1,149
1050MB	10ms	3.5" HH	Micropolis	IDE/SCSI	MC2112A/S	1,259	1,279/1,409
1080MB	10ms	3.5" HH	Fujitsu	SCSI	FJ2694S	1,099	1,249
1200MB	9ms	3.5" HH	Maxtor	SCSI	MX124ØS	1,559	1,709
1420MB	15ms	5.25" FH	Seagate	SCSI	ST4165ØN	1,349	1,499
1748MB	14ms	5.25" FH	Micropolis	SCSI	MC1548	1,299	1,449
1750MB	11ms	5.25" FH	Fujitsu	SCSI	FJ2652S	2,199	2,349
1900MB	12.9ms	5.25" FH	Seagate	SCSI	ST421ØØN	1,549	1,699
2060MB	12ms	5.25" FH	Fujitsu	SCSI	FJ2654S	2,349	2,499
2100MB	11ms	5.25" FH	Micropolis	SCSI	MC1924	2,699	2,849
2120MB	11ms	5.25" FH	Seagate	SCSI	ST424ØØN	2,349	2,499
2900MB	12ms	5.25" FH	Seagate	SCSI	ST434ØØN	2,999	3,149

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DRIVE KITS INCLUDE:

- Complete installation kit, including:
  - 5 1/4" mounting frame
  - Data Cable
  - Rail Set
  - Screws
  - Jumper Blocks
  - Bezels
- HDI's Hard Drive Reference Manual with step-by-step installationinstructions.

FOR 8 BIT (PC/XT) KITS ADD:

- Controller (when applicable)

For 16 BIT (286/386/486) KITS ADD:

- 1" to 1" interleave hard/floppy Controller or appropriate interface.

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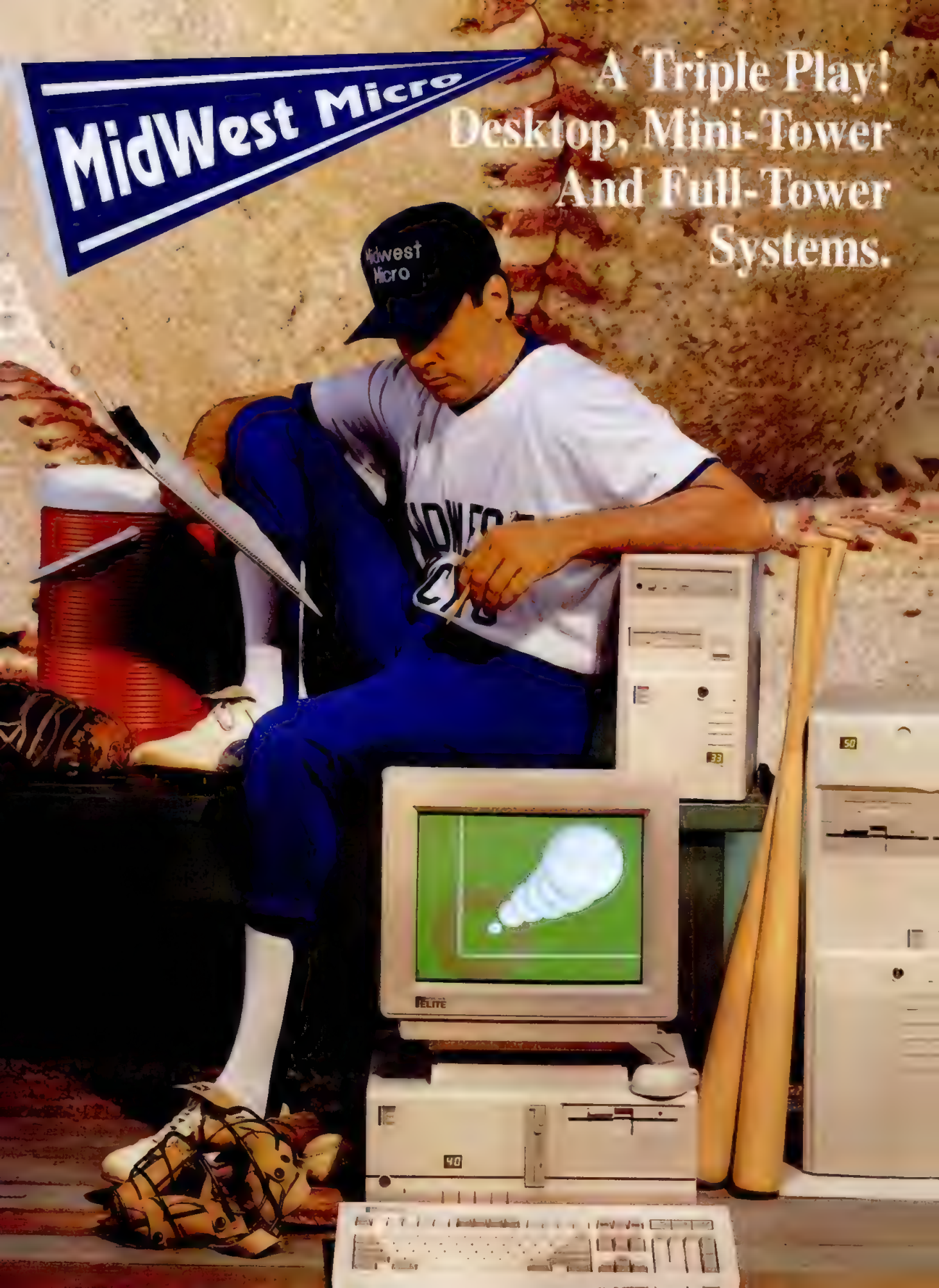
Educational Fax - 602-902-1177
International - 602-350-1145

800-927-2906

CIRCLE 219 ON READER SERVICE CARD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A Triple Play!
Desktop, Mini-Tower
And Full-Tower
Systems.
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33
50
40

MidWest Micro—Known For Our Hard-Hitting Products

At MidWest Micro, we build products that last—like Elite Computer Systems. But that's really no surprise. Afterall, the Midwest is where professional baseball began...and where Louisville Sluggers are made.

Our manager knows a team is only as strong as its weakest player. So, just as Louisville Sluggers are made from the choicest woods, Elite Computers are constructed from the finest components. Each Elite System is custom designed and engineered for superior performance and reliability.

First we select durable cases to hold and protect our Elite Systems. Then we add the fastest motherboards, the most reliable hard drives and the highest-resolution monitors.

Your Chance For A Steal

With Elite Systems, you have the hometown advantage. Elite Computers are assembled on-site to eliminate double handling costs and ensure strict quality control. Elite Systems come with SVGA cards, high-speed RAM boards, 3.5" floppy drives, formatted hard drives and Microsoft DOS 6.0 and Microsoft Windows* installed. When your Elite arrives, it's ready to go. Simply open the box—plug it in—and start computing.

At MidWest Micro You're Never Out

You're always a winner with MidWest Micro. Each Elite System comes backed by a 30-Day Complete Satisfaction Guarantee, a Full-Year Limited Warranty, an Immediate Parts Replacement Policy and 72-Hour Repair Service. And since all Elite Systems are repaired on the premises, you're guaranteed the fastest turn around time and best service available.

Fielder's Choice

Each Elite Computer comes with a number of options so you'll never outgrow your system. For details on our complete line of hard drives, monitors, tape backups, memory upgrades, modems, printers and more, call your MidWest Micro Representative at 1-800-572-8844.

Fast Delivery

You'll need a radar gun to clock our fast delivery. Most standard configurations are shipped within 24 hours. If you'd prefer a custom configuration, we'll do our best to have it on your doorstep within 72 hours.

**Some configurations do not ship with Windows.*

The Major Leagues

Deluxe ISA Systems

486DX-33 — $1369
#003360
Statistics:
- 80486DX-33 Processor
- 128K High-Speed Cache
- 4 Mb High-Speed RAM
- 130 Mb IDE Hard Drive
- 1.44 Mb 3.5" Floppy Drive
- 1.2 Mb 5.25" Floppy Drive
- 14" SVGA .28 Non-Interlaced Color Monitor
- 16-Bit SVGA Card with 1 Mb
- 1 Parallel, 2 Serial & 1 Game Port
- 101-Key Enhanced Keyboard
- High-Resolution, 3-Button Mouse
- 5-Bay Mini-Tower Case
- ***FREE*** Microsoft DOS 6.0 *Installed*
- ***FREE*** Microsoft Windows *Installed*

486DX2-50 — $1479
#003361

486DX-50 — $1519
#003362

486DX2-66 — $1599
#003363

VESA Ready Deluxe Systems

486SX-33 — $999
#006300
Statistics:
- VESA Local Bus Motherboard
- 80486SX-33 Processor
- 128K High-Speed Cache
- 2 Mb High-Speed RAM
- 80 Mb IDE Hard Drive
- 1.44 Mb 3.5" Floppy Drive
- 14" SVGA .39 Color Monitor
- 16-Bit SVGA Card with 512K
- 1 Parallel, 2 Serial & 1 Game Port
- 101-Key Enhanced Keyboard
- 5-Bay Mini-Tower Case
- ***FREE*** Microsoft DOS 6.0 *Installed*

486SX-33 — $1279
#006301
Statistics:
- VESA Local Bus Motherboard
- 80486SX-33 Processor
- 128K High-Speed Cache
- 4 Mb High-Speed RAM
- 130 Mb IDE Hard Drive
- 1.44 Mb 3.5" Floppy Drive
- 1.2 Mb 5.25" Floppy Drive
- 14" SVGA .28 Non-Interlaced Color Monitor
- 16-Bit SVGA Card with 1 Mb
- 1 Parallel, 2 Serial & 1 Game Port
- 101-Key Enhanced Keyboard
- High-Resolution, 3-Button Mouse
- 5-Bay Mini-Tower Case
- ***FREE*** Microsoft DOS 6.0 *Installed*
- ***FREE*** Microsoft Windows *Installed*

VESA Ready Multimedia Systems

486DX-33 — $1769
#006308
Statistics:
- VESA Local Bus Motherboard
- 80486DX-33 Processor
- 128K High-Speed Cache
- 4 Mb High-Speed RAM
- 170 Mb IDE Hard Drive
- 1.44 Mb 3.5" Floppy Drive
- Internal Multimedia CD-ROM Drive with Software Library
- High-Performance Sound Card
- Digital-Quality, Compact Speakers
- 14" SVGA .28 Non-Interlaced Color Monitor
- 16-Bit SVGA Card with 1 Mb
- 1 Parallel, 2 Serial & 1 Game Port
- 101-Key Enhanced Keyboard
- High-Resolution, 3-Button Mouse
- 5-Bay Mini-Tower Case
- ***FREE*** Microsoft DOS 6.0 *Installed*
- ***FREE*** Microsoft Windows *Installed*

486DX2-50 — $1879
#006309

486DX2-66 — $1999
#006310

VESA Value Systems

486DX-33 — $1469
#006302
Statistics:
- VESA Local Bus Motherboard
- 32-Bit VESA Local Bus SVGA Video Card
- 32-Bit VESA Local Bus IDE Card
- 80486DX-33 Processor
- 128K High-Speed Cache
- 4 Mb High-Speed RAM
- 170 Mb IDE Hard Drive
- 1.44 Mb 3.5" Floppy Drive
- 1.2 Mb 5.25" Floppy Drive
- 14" SVGA .28 Non-Interlaced Color Monitor
- 1 Parallel, 2 Serial & 1 Game Port
- 101-Key Enhanced Keyboard
- High-Resolution, 3-Button Mouse
- 5-Bay Mini-Tower Case
- ***FREE*** Microsoft DOS 6.0 *Installed*
- ***FREE*** Microsoft Windows *Installed*

486DX2-50 — $1579
#006303

486DX2-66 — $1699
#006304

VESA Windows Systems

486DX-33 — $1699
#006305
Statistics:
- VESA Local Bus Motherboard
- 32-Bit VESA Local Bus IDE Card
- 80486DX-33 Processor
- 128K High-Speed Cache
- 4 Mb High-Speed RAM
- 210 Mb IDE Hard Drive
- 1.44 Mb 3.5" Floppy Drive
- 1.2 Mb 5.25" Floppy Drive
- 15" SVGA .28 Non-Interlaced Multi-Scan Color Monitor
- Diamond Stealth 24 VESA Local Bus SVGA Video Card
- 1 Parallel, 2 Serial & 1 Game Port
- 101-Key Enhanced Keyboard
- High-Resolution, 3-Button Mouse
- 7-Bay Full-Tower Case
- ***FREE*** Microsoft DOS 6.0 *Installed*
- ***FREE*** Microsoft Windows *Installed*

486DX2-50 — $1809
#006306

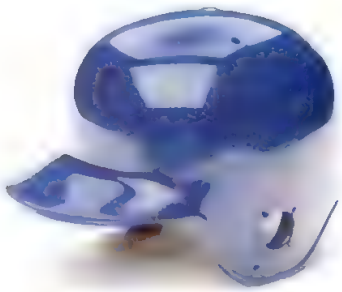
486DX2-66 — $1929
#006307

VESA CAD Systems

486DX-33 — $2329
#006311
Statistics:
- VESA Local Bus Motherboard
- 32-Bit VESA Local Bus IDE Card
- 80486DX-33 Processor
- 128K High-Speed Cache
- 8 Mb High-Speed RAM
- 340 Mb IDE Hard Drive
- 1.44 Mb 3.5" Floppy Drive
- 1.2 Mb 5.25" Floppy Drive
- 17" SVGA .28 Non-Interlaced Digital Color Monitor
- Diamond Stealth 24 VESA Local Bus SVGA Video Card
- 1 Parallel, 2 Serial & 1 Game Port
- 101-Key Enhanced Keyboard
- High-Resolution, 3-Button Mouse
- 7-Bay Full-Tower Case
- ***FREE*** Microsoft DOS 6.0 *Installed*
- ***FREE*** Microsoft Windows *Installed*

486DX2-50 — $2439
#006312

486DX2-66 — $2559
#006313



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Elite 486SLC-33 Notebooks

MidWest Micro

Elite 486SLC-33 Subnote

When The Game Goes Into Extra Innings, You'll Be Glad You Have An Elite

Not only do the Elite 486SLC-33 Color and Monochrome Notebooks give you more computing power, they give you the power to compute longer. Use the SUSPEND/RESUME feature to avoid unnecessary system rebooting and compute up to 6 hours on a single charge*.

For those afternoon games, the Elite provides a large, non-glare VGA screen that eliminates distortion, flickering and eye strain so you can compute comfortably. Text and graphics appear at 640 x 480 resolution in 64 gray shades or 256 colors.

And if you get caught up in the action, a quick glance at the LCD panel lets you know which drives are being accessed, when battery power is low, what function keys are enabled, whether external power is being used and if there is a modem ring. With the Elite's LCD panel, you'll never feel like you're out in left field.

Elite 486SLC-33 Color

Model	Item #	Price
80 Mb	005461	$1699
120 Mb	005466	$1769
200 Mb	005471	$1889

Elite 486SLC-33 Monochrome

Model	Item #	Price
80 Mb	005446	$1209
120 Mb	005451	$1279
200 Mb	005456	$1399

Statistics:

Processor:
Cyrix 486SLC
Processing Speed:
33 MHz
RAM:
2 Mb RAM, expands to 8 Mb
Hard Drive:
80 Mb, 120 Mb or 200 Mb
Floppy Drive:
Built-in 1.44 Mb 3.5"
Screen:
Color - 9", 256 colors
Monochrome - 10", 64 gray shades
Video RAM:
Color - 512K
Monochrome - 256K

Keyboard:
83 key with 101-key emulation
2-button thumball mouse
Weight:
Color - 5.7 lbs. with battery
Monochrome - 5.4 lbs. with battery
Battery Life*:
Color - 4 hours
Monochrome - 6 hours
640 x 480 resolution
Simultaneous video
Advanced Power Management
One parallel and one serial interface
External VGA monitor and keyboard connectors
FREE* AC adapter carrying case and MS-DOS 6.0 *installed
One-year manufacturer's warranty

Take Me Out To The Ball Game

Compact and lightweight, the 486SLC-33 fits you like a glove. It weighs only 3.7 lbs. and measures 10" x 7" x 1.6", but is more advanced than notebooks twice its size. The Elite 486SLC-33 Subnote comes with a 33 MHz Cyrix processor and 2 Mb of RAM. Need grand slam power? Add an easy-to-install RAM upgrade or take advantage of the latest technology with the Subnote's Type II PCMCIA interface. It allows you to install PCMCIA cards for flash memory, modems and network adapters.

You'll never run out of storage space with the Elite Subnote. Once you fill its 80 Mb removable hard drive, simply take it out and insert another hard drive. There's no limit to the number of hard drives you can fill...or files you can save.

You'd think a small sub notebook would be hard to work on—but it's not. The Elite Subnote rounds out its bases with a 7.4" high-contrast screen that displays 640 x 480 VGA resolution and 64 gray shades.

Elite 486SLC-33 Subnote

Model	Item #	Price
80 Mb	005415	$1359

Statistics:

Processor:
Cyrix 486SLC
Processing Speed:
33 MHz
RAM:
2 Mb RAM, expands to 8 Mb
Hard Drive:
Removable 80 Mb hard drive
Screen:
7.4" high-contrast screen
640 x 480 VGA resolution
64 gray shades
Video RAM:
256K
Weight:
3.7 lbs. with battery
Size:
10" x 7" x 1.6"

Battery:
Nickel metal hydride battery
Up to eight hours with APM*
Keyboard:
79-key with 101-key emulation
Built-in 2-button trackball
Drag button
Interfaces and Ports:
Parallel and serial interfaces
External keyboard, monitor and modem connectors
External floppy port
PCMCIA Type II slot
Advanced Power Management
Simultaneous video
***FREE* external 3.5" 1.44 Mb floppy drive, AC adapter and utilities support disk**
FREE* MS-DOS 6.0 *installed
One-year manufacturer's warranty

*Battery life measured with Power Management enabled. Actual battery life may vary.

Elite 486SX/DX Notebooks

MidWest Micro

Elite 486SX-25 Subnote

With 27 Notebooks to choose from, everyone is a player.

Everyone loves our new line of Elite 486 Notebooks. Choose your Elite with an Intel 486SX-25, 486DX-33 or 486DX2-50 processor, select an active color, dual-scan color or monochrome screen and then pick the hard drive that best meets your needs—from 80 Mb up to 200 Mb!

No matter which processor, screen or hard drive you choose, your Elite 486 Notebook comes standard with 4 Mb of RAM and can be upgraded to 20 Mb.

Isn't it a relief to know that whether you're a teacher, doctor, lawyer, sales representative, student or homemaker, there's an Elite 486 Notebook perfectly matched to your needs...*and* your budget?

Statistics:

Processor:
Intel 486SX-25, 486DX-33 or 486DX2-50
RAM:
4 Mb, expands to 20 Mb
Hard Drive:
80 Mb, 120 Mb or 200 Mb
Screen:
10", 640 x 480 VGA resolution
Backlit display
Color - 256 colors
Monochrome - 64 gray shades
Battery Life*:
Active Color - 3 hours
Dual-Scan Color - 4 hours
Monochrome - 6 hours

Weight:
Color - 6.9 lbs.
Monochrome - 6.4 lbs.
512K Video RAM
86 keys with 101-key emulation
Built-in trackball
Built-in 1.44 Mb, 3.5" floppy drive
Advanced Power Management
One parallel and one serial port
External VGA and keyboard connectors
One PCMCIA Type III slot/ two Type II slots
***FREE* AC adapter and utilities disk**
***FREE* MS-DOS 6.0 installed**

486SX-25 Elite Notebooks

	Monochrome	Dual-Scan Color	Active Color
80 Mb	$1599 #005500	$2339 #005505	$3219 #005510
120 Mb	$1649 #005501	$2389 #005506	$3269 #005511
200 Mb	$1739 #005502	$2489 #005507	$3369 #005512

486DX-33 Elite Notebooks

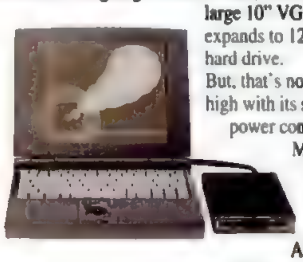
	Monochrome	Dual-Scan Color	Active Color
80 Mb	$1869 #005515	$2599 #005520	$3489 #005525
120 Mb	$1919 #005516	$2659 #005521	$3539 #005526
200 Mb	$1999 #005517	$2749 #005522	$3629 #005527

486DX2-50 Elite Notebooks

	Monochrome	Dual-Scan Color	Active Color
80 Mb	$2089 #005530	$2839 #005535	$3719 #005540
120 Mb	$2139 #005531	$2889 #005536	$3759 #005541
200 Mb	$2239 #005532	$2979 #005537	$3859 #005542

The Best In The Field...

If you're looking for a powerful portable, the Elite 486SX-25 Subnote is a great catch. Weighing a mere 3.9 lbs., the 486SX-25 Subnote features a large 10" VGA screen, 4 Mb of RAM that expands to 12 Mb and up to a 200 Mb hard drive.



But, that's not all! The Elite Subnote scores high with its special Intel processor for low power consumption, Advanced Power Management and PCMCIA Type II slot for modems, flash memory, network adapters and more.

All this for under $1500? Only at MidWest Micro—so call us today and get your Elite Subnote for peanuts.

486SX-25 Subnote

Model	Item #	Price
80 Mb	005575	$1499
120 Mb	005576	$1549
200 Mb	005577	$1639

Statistics:

Processor:
Intel 486SX
Processing Speed:
25 MHz
RAM:
4 Mb expands to 12 Mb
Hard Drive:
80 Mb, 120 Mb or 200 Mb
Screen:
10", 640 x 480 VGA resolution
Backlit display
64 gray shades

Battery Life*:
5 hours
Weight:
3.9 lbs.
512K Video RAM
83 keys with 101-key emulation
Built-in trackball
External 1.44 Mb, 3.5" floppy drive
Advanced Power Management
One parallel and one serial port
External VGA and keyboard connectors
One PCMCIA Type II slot
***FREE* AC adapter**
***FREE* MS-DOS 6.0 installed**

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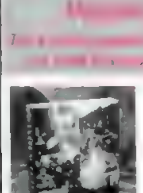

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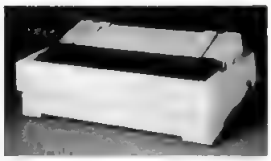

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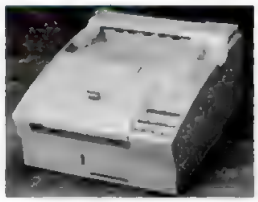

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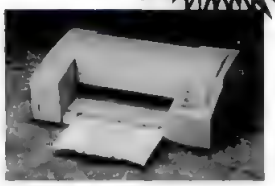

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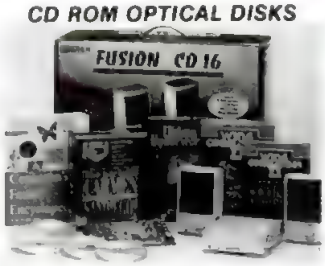

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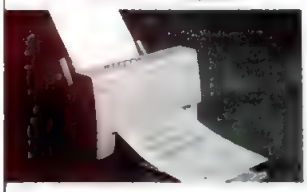

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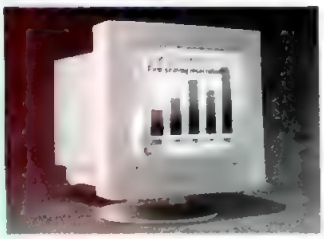

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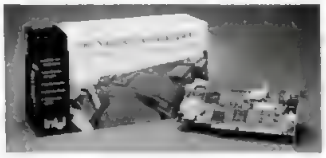

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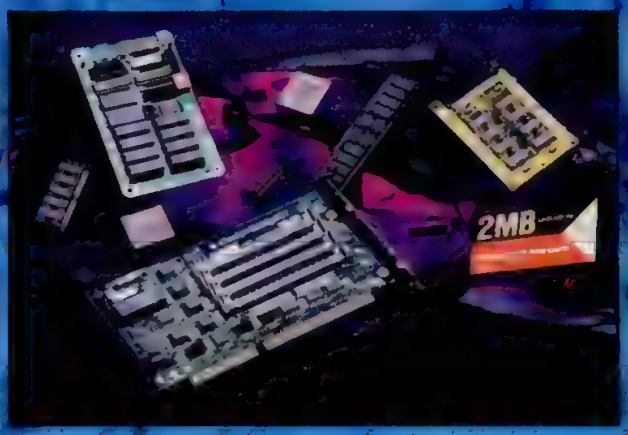

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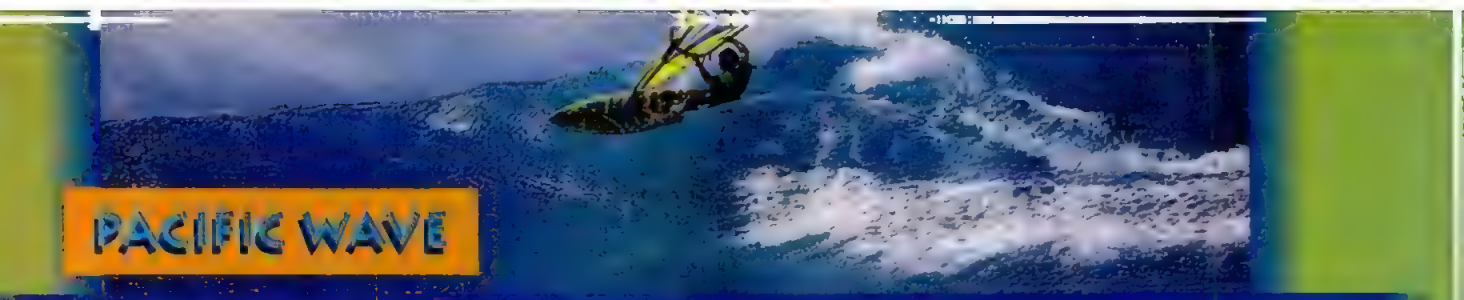

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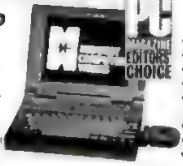

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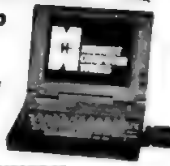

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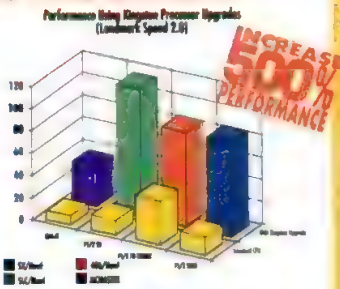

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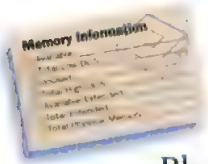

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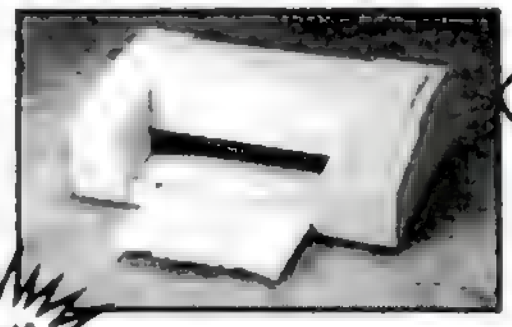

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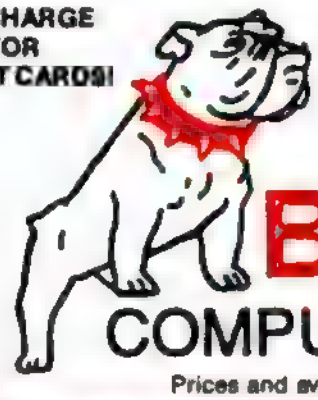

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Bravo 486	4Meg	500987-002		165 00
	8Meg Kit	500987-003		330 00
	16Meg	500987-004		655 00
Premium 386/25, 16 SX	1Meg	500718-001		55 00
Premium 386/33	1Meg	500718-002		56 00
Premium II	1Meg	500780-003	WPB	60 00
386SX20, 486-25 25E, 33	4Meg	500780-004	WPB	160 00
Premium Tower, 386/33TE, 486/25TE, 486/33TE	8Meg	500780-001	WPB	320.00
Cupid Memory Board	0-32Meg	500818-001		149.00

ZENITH MEMORY MODULES

MODEL	AMT. UPGRADED	AST PART #		PRICE
Z386/33, 25, 20, 33E	1Meg	ZA3800ME		50 00
Z386/33, 25, 20, 33E, 486/25E	4Meg	ZA3800MK		160 00
Z386SX	2Meg	Z-605-1	modules	99 00

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30F5360 (2Meg)	30-286, 25-286, 50 MTHR BD.	79 00
33G9288 (2Meg)	Thinkpad 300.	109 00
33G9288 (8Meg)	Thinkpad 300.	339 00
6450375 (1Meg)	80-041	79 00
6450379 (2Meg)	80-111, 311-121, 321, 081, 161	94 00
6451060 (4Meg)	80-A21, A-61, 80-A31, 80-111, 80-311	189 00
6450603 (1Meg)	35SX, 40SX, 55SX, Model-70's, P-70	45 00
6450604 (2Meg)	70-061 E61, 121, 50Z, 55SX, 65SX, P-70, 55LS, 65LS, X-Station 120 & 130, 35SX, 35LS, 40SX	82.00
6450608 (2Meg)	70-A21, A-61, B-21, B-61, 35SX, 35LS, 40SX Value Point 325T	86.00
78X8955 (128K)	25	35 00
34F2933 (4Meg)	35SX, 40SX, 55SX, 65SX, 55LS, 65LS	159 00
87F9977 (4Meg)	55SX, 55LS, 65SX, 40SX, 35SX, 35LS	159 00
1057035 (512K)	P/S1-286	40 00
92F9935 (2Meg)	P/S1 & P/S1/386SX-2121	92 00
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MODEL	AMT. UPGRADED	COMPQ PART #	PRICE
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	8Meg Module	116561-001	339 00
	32Meg Module	116568-001	1500 00
DeskPro 386/33L, 486/33L	(Exp Bd)	116569-001	289 00
DeskPro 386/25, 386/20	1Meg Module	113131-001	79 00
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DeskPro 386/20E	1Meg Exp Bd	113644-001	119 00
DeskPro 386/25E	4Meg Exp Bd	113645-001	239 00
	1Meg Module	113131-001	75 00
	4Meg Module	113132-001	174 00
DeskPro 286N, 386N, 386SX/20, 386/25M, 486/33M, 486S/25M, 486S/16M	1Meg Module	118688-001	50 00
	2Meg Module	118689-001	85 00
	4Meg Module	118690-001	149 00
Port. 486C	8Meg Module	128877-001	309 00
M Series Exp Bd	0-64Meg	129160-001	279 00
DeskPro 386/16	1Meg Kit	108071-001	99 00
	4Meg Kit	108072-001	269 00
	1-2Meg Exp Bd	108069-001	239 00
	4-8Meg Exp Bd	108070-001	399 00
DeskPro 286	512K Kit	113012-001	59.00
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	8Meg	141742-001	299 00
Prolinea 486 4/25S, 4/33, 4/50, 4/66, CDS	1Meg	141682-001	55 00
	2Meg	141683-001	98 00
	4Meg	141684-001	159 00
	8Meg	141685-001	319 00
Prosignia PC Server, 486/33, 486 DSX/66	8Meg	141685-001	349 00
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LTE LITE/20, 25, 25C	4Meg Module	129769-002	199 00
LTE LITE/20, 25, 25C	8Meg Module	129769-003	319 00
LTE LITE/20, 25, 25C	16Meg Module	129769-004	699 00
LTE LITE 4/25C	4Meg Module	142337-002	199 00
LTE LITE 4/25C	8Meg Module	142337-003	299 00
LTE LITE 4/25C	16Meg Module	142337-004	749 00
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T2000SX,T1000LE	4Meg	PC-PA8314U	159 00
T2000SX,T1000LE	8Meg	PC14-PA8315U	279 00
T2000SXE/2200SX,T1800 1850, C	2Meg	PC-PA2000U	84 00
T2000SXE/2200SX,T1800, 1850, C	4Meg	PC-PA2001U	159 00
T2000SXE/2200SX,T1800, 1850, C	8Meg	PC-PA2002U	279 00
T4400SX, SXC T6400	4Meg	PC-PA2004U	164 00
T4400SX, SXC T6400	8Meg	PC-PA2005U	299 00
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T4500 T4500C T4600 T1900 T1900C (3 3 v)	4Meg	PC-PA2012U	239 00
T4500 T4500C T4600 T1900 T1900C (3 3 v)	8Meg	PC-PA2013U	419 00
T4500 T4500C T4600 T1900 T1900C (3 3 v)	16Meg	PC-PA2014U	1299 00
T4500 T4500C T4600 T1900 T1900C (3 3 v)	32Meg		3299 00
T3300SL	4Meg	PC-PA2007U	169 00
T3300SL	6Meg	PC-PA2008U	229 00
T3300SL	8Meg	N/A	369 00
T3300SL	16Meg	PC-PA2009U	749 00
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T3100SX	4Meg	PC15-PA8310U	164 00
T3200	3Meg	PC8-PA7137U	159 00
T3200SX	2Meg	PC12-PA8307U	85 00
T3200SX	4Meg	PC12-PA8309	164 00
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T3200SXC	4Meg	PC19-PA8319U	164 00
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T5200/T8500	2Meg	PC10-PA8304U	89 00
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ALR Venture	4Meg	12407980	229 00
AST Notebook Prem Exec 386SX/20/25/25L	4Meg	500814-003	149.00
AST Power Exec 3/25C, 425EL	4Meg		179 00
AST Power Exec 425SL	4Meg		249 00
AST Power Exec 425SL	16Meg		1319 00
AT&T Safari NSX/20	4Meg	PEC 37651	189 00
Bondwell B310, Plus	1Meg	23050-09100	109 00
Bondwell B310V, SX	1Meg		109 00
Bondwell B310V, SX	4Meg		219 00
Epson NB3	4Meg	A808511	179 00
Epson NB/SL 20,25,25C	2Meg	A808771	129 00
	4Meg	A808781	219 00
	8Meg		479 00
Everex Tempo LX, LX20	2Meg	PCA 00053-0001	89 00
Everex Tempo Carrier	2Meg	PWA 0884-A-J000	119 00
Goldstar GS520 386SX/16	4Meg	S386-4M	239 00
Leading Edge D/LT 386SX	1Meg		109 00
Magnavox Metalis	1Meg, 4Meg	286, 386SX	99.00,189 00
NCR 3170	4Meg	3123-K104-V001	239 00
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NCR 3170	16Meg	3123-K116-V001	925 00
NEC Prospeed 286, 386SX-16	1Meg	PC21-21	105 00
NEC Prospeed 286, 386SX-16	4Meg	PC21-22	179 00
NEC Prospeed 386	2Meg	PC31-21	129 00
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NEC Prospeed 386SX-20	1Meg	PC43-21	109 00
NEC Prospeed 386SX-20	4Meg	PC43-22	199 00
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NEC Ultralite III/SL/25C	4Meg	PC47-22	219 00
NEC Ultralite SL/20, 20P	6Meg	PC49-21	269 00
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TI 4000	4Meg, 16Meg		199.00, 1599.00
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Compaq Pagemarq	-	-	69	99	-	-	169	-	-	299	-	-
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Epson Action Laser II	-	-	99	-	169	-	-	249	-	-	-	-
Epson 8000	-	-	99	-	169	-	-	249	-	-	-	-
Epson 1000	-	-	-	72	-	-	144	-	216	-	-	-
HP 2, 2D, 3, 3D 3P, 2P 2P+	-	-	-	99	-	-	159	-	-	-	-	-
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HP 4SI	-	-	-	80	-	-	149	-	-	309	-	-
HP Deskjet 500, 500C, 550	-	55	-	-	-	-	-	-	-	-	-	-
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HP Paintjet XL300	109	-	-	-	-	-	268	-	-	-	745	-
IBM Laser 4019, 4019E	-	-	-	-	-	144	-	-	-	-	-	-
IBM Laser 4029	-	-	-	-	-	-	139	-	-	-	-	-
IBM Laser 4039	-	-	-	-	-	-	169	-	-	319	-	-
NEC 90, 290	-	-	-	109	-	-	-	-	-	-	-	-
NEC 95	-	-	-	99	-	-	-	-	-	-	-	-
Oki 400	-	-	-	94	-	-	-	-	-	-	-	-
Oki 830, 840	-	-	-	109	-	-	-	-	-	-	-	-
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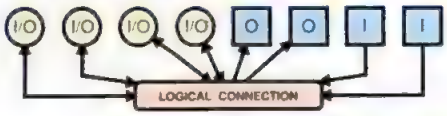

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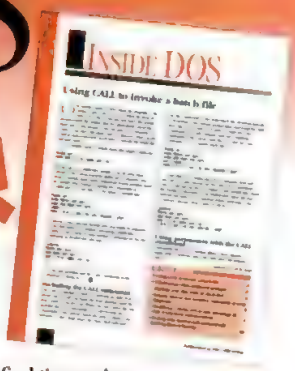

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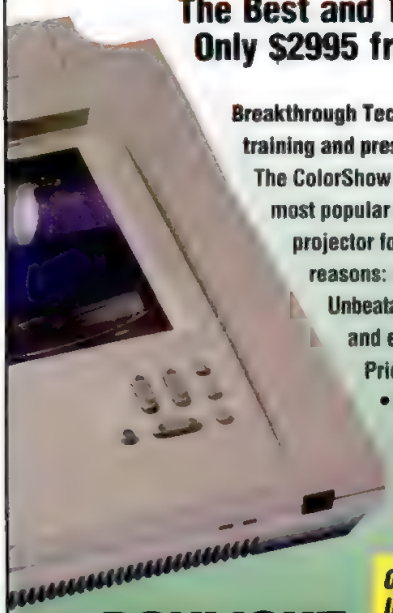

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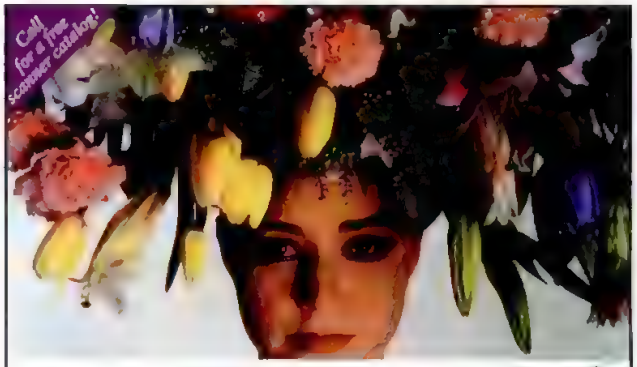

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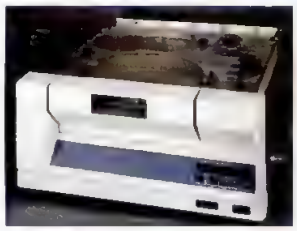

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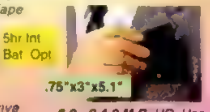

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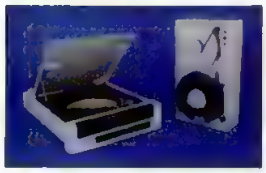

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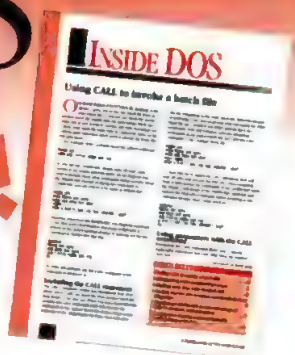

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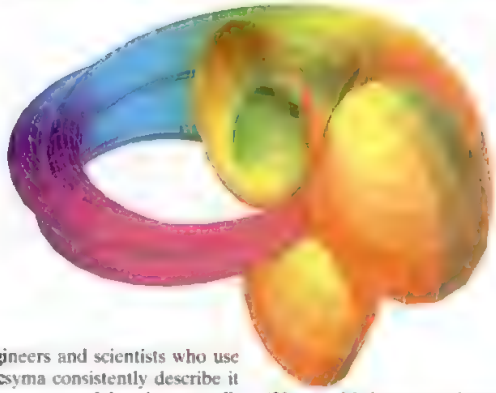

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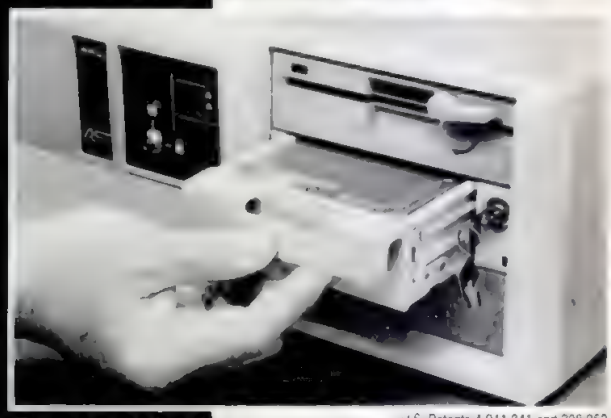

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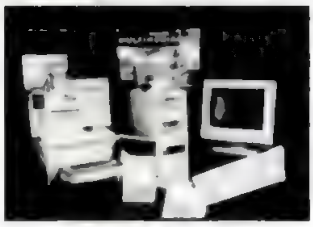

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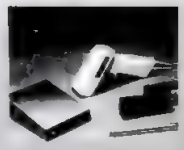

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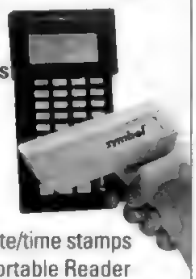

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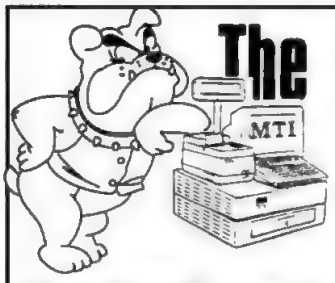

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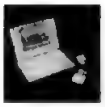

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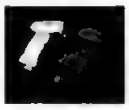

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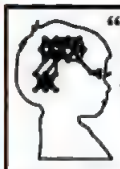

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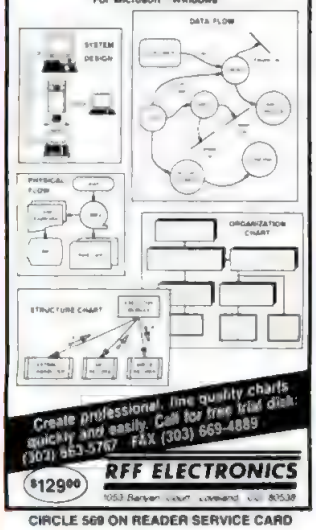

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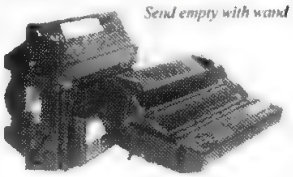

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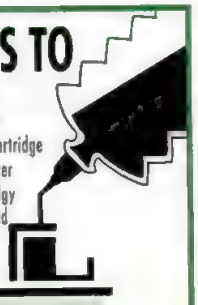

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PC MAGAZINE

Coming Up

Pens & PDAs

A new "personal" computing era is dawning with the emergence of tiny, portable pen-based personal digital assistants (PDAs). The wider pen-computer market also is expanding as new general-purpose and vertical solutions are introduced. *PC Magazine* examines the first group of PDAs to hit the market, including Apple's Newton MessagePad, the Tandy Z-PDA/Casio XL-7000 Zoomer, and AT&T's EO 440 Personal Communicator. We also take a look at a spectrum of pen-based systems—including larger pen-based notebooks and vertical-market specialty tablets. To round out the review, we look at keyboard-based hand-held personal organizers.

Image Editing

The Macintosh no longer reigns supreme as the platform of choice for manipulating or sprucing up your photographs. Image-editing software for the PC has become more powerful and flexible than ever before for both color-production professionals and business users. *PC Magazine* reviews nine state-of-the-art packages that will help cure PC image-editing users of Mac envy. Depending on your needs, one of these products may be the right one for you.

Bibliography Software

Professors, writers, and librarians: Fret no more. Software that is designed to simplify the painstaking process of compiling bibliographies is now faster and easier to use than ever. *PC Magazine* will look at six bibliography packages to help you decide which one of the programs is right for you.

Client/Server Databases

Can you bet your business on PC-based SQL databases? More and more people are taking that kind of a risk. But when you pick a system for your mission-critical, enterprise-wide data, there's absolutely no room for error. We torture-test seven PC-based SQL database systems to answer the question: How much can they take?

Free Utility

Windows 3.1's Program Manager lets you assign hotkeys to your programs, but it offers only a limited range of hotkey combinations. HOTKEY, our next issue's free utility, offers a much wider selection of possible keystrokes, and it also lets you use hotkeys to launch applications without switching to the Program Manager first.

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After Hours

THE DESKTOP ATHLETE: Michael Jordan In Flight; HardBall III; Front Page Sports Football; World Circuit: Grand Prix Race Simulation; Links 386 Pro/Microsoft Golf

THE DESKTOP ATHLETE

Five Sports Simulation Programs Challenge Computer Jocks

BY DONALD B. TRIVETTE

Sports are easily America's most popular pastime, drawing avid fans and eager participants. Now the roar of the crowd, the swish of the net, the crack of the bat, and the smell of burning rubber are as near as your PC.

Because there are so many sports simulations on the market, ranging from awesome to awful, it's tough knowing which one to buy. We've run bases, blocked shots, hooked, sliced, punted, and crashed to come up with the best games.

Electronic Arts' Michael Jordan In Flight is the most impressive sports simulation on the market; its breakthrough 3-D technology and animation blow the others away. Front Page Sports Football, from Dynamix, is the most comprehensive and detailed simulation, with as much attention given to team management as to actual play. HardBall III, with its play-by-play commentary by a professional sports announcer, is the ultimate in computer baseball, and World Circuit gives you a sense of speed and motion that leaves other racing software in the dust. Finally, Links 386 Pro and its close cousin Microsoft Golf cast the best light on golf for 386s running DOS and Windows.

ELECTRONIC ARTS

Michael Jordan In Flight

Michael Jordan In Flight, from Electronic Arts, looks like no other computer game you've ever seen. It looks like TV. The camera travels and pans to follow the action, as the three-dimensional players dribble around the court.

These players aren't stick figures or blobby little icons; these guys have muscle and motion. These guys have the moves, and the king of the moves is Michael Jordan, whose grace and stealth are so familiar to basketball fans.

To attain this realism, the developers videotaped Michael Jordan and his signature moves from eight different angles. Then they digitized and compressed the images into an electronic Jordan that you can control. As a result, the motion is incredibly lifelike, and you can view the action from anywhere on or above the court.

All games are three-on-three, half-court, since only six players can reasonably fit on a computer screen. You control Jordan and his home high school team of Wilmington, North Carolina. A tracking option lets you be Michael Jordan or whoever has the ball. Jordan is always on your team, but you pick two other teammates and a substitute from a roster of fictitious players. There is no two-player mode; the computer always is your opponent.

WHAT LEARNING CURVE?

The second feature that makes Michael Jordan In Flight a standout is the learning curve. There is none. Just grab the mouse and head for the court. The left button passes and steals, and the right button shoots and blocks. Four plays—low post cutter, high post cutter, give 'n' go, and backdoor screen—are called by pressing number keys. Just calling plays, however, isn't enough; you've got to make sure that passing lanes are clear and that you outmaneuver the aggressive defense.

Swish! Michael Jordan In Flight lets you make Jordan's signature moves.

Michael Jordan In Flight can also give aspiring TV sports directors plenty of practice. Put the play on automatic and concentrate on selecting camera angles and views for the folks back home. Want to see that double-pump jam again? No problem: Instant replay from virtually any angle is just a mouse click away.

After the game, go to the video-edit lab and prepare the highlight films. The possibilities are endless.

Michael Jordan In Flight requires at least a 16-MHz 386 processor, although a 33-MHz 486 or better is wisely recommended. The slower processor is really too slow to do justice to the splendid animation. The only problem I encountered was with the high-resolution graphics. Electronic Arts doesn't yet have drivers for all 640-by-480 video cards, so you may have to play in low-resolution (320-by-200) mode until drivers are available.

Overall production values are very good, however. For example, the sound of the ball bouncing on the hardwood floor is synchronized with the action.

Michael Jordan In Flight, *$59.95* Requires: *2MB RAM, 3.5MB hard disk space, DOS 3.3 or later, EMS 4.0 driver. Electronic Arts, 1450 Fashion Island Blvd., San Mateo, CA 94404; 800-245-4525, 415-571-7171; fax, 415-571-8004.*

Circle 481 on reader service card

ACCOLADE INC.

HardBall III

HardBall III, from Accolade, takes you out to the ball game at any of eight accurately rendered stadiums.

Grab a bat and step up to

the plate for an exhibition game between Chicago and Philadelphia. This is the easiest level on which to play, since there's no team editing or league scheduling to consider. You face a pitcher who can deliver eight different pitches, from curves and knucklers to crazy screwballs, and he can put them just about anywhere he wants.

You, as the batter, have three swings: a standard swing, a power swing, and a bunt.

Multiple views: HardBall III shows you the view from the plate or the mound.

Your perspective as batter is normally from behind home plate, and your perspective as pitcher is normally over the pitcher's shoulder, but you can change these. Actual hitting and pitching are accomplished by joystick or keyboard; the mouse is used only for making menu selections.

REAL COMMENTARY

New to this version of HardBall are sharp VGA graphics, instant replays, and play-by-play descriptions by Al Michaels, the veteran ABC sportscaster. Although his optional commentary requires 2MB of RAM, it makes the game much more realistic. Close your eyes and you'll swear you're listening to TV.

The 26 teams in HardBall are patterned after real teams, and the players are statistical composites of real players. If you want to boost a player's skill—say, make him a better fielder—use the Edit Player menu to increase his running ability. Almost everything about a player and his team can be changed, down to the color of the uniforms.

If you need to brush up on your skills, step into batting practice. Here you can pick the types and locations of pitches or use random pitches to test your dexterity. I found half an hour in the batting cage measurably improved my batting average.

Batting practice and exhibition games are just a warm-up for league play, the heart of HardBall III. You can elect a short season, half season, or the full 162-game series. At the halfway point, the computer picks an All Stars team based on league statistics and plays the match. Of course, the World Series follows at the end of the season.

Besides the eight original stadiums, Accolade sells a disk with 18 of the remaining 20 major league ball parks for $25. (Sorry, Marlins and Rockies fans.) You can play against the computer or a friend, or you can be a spectator while the computer takes both sides. It takes about 20 minutes to simulate a week of league activity. About the only thing HardBall III doesn't serve up is peanuts and hot dogs.

HardBall III, *$59.95.*
Requires: *640K RAM, 2MB hard disk space, DOS 3.3 or later. Accolade Inc., 5300 Stevens Creek Blvd., San Jose, CA 95129; 800-245-7744, 408-985-1700; fax, 408-246-0885.*
Circle 482 on reader service card

DYNAMIX INC.

Front Page Sports Football

The most comprehensive simulation in the group, Dynamix's Front Page Sports Football has action, statistics, team management, and league play. This is not a quick-study computer football game. Success requires reading, practice, and at least a quick look at the ten-step on-line tutorial.

The fastest way to get your hands on the ball is to choose Quick Start from the menu. This mode sets up an exhibition game between Washington and Buffalo, and runs plays using the basic play-calling mode. In this game, you select plays—run left, pass long middle, goal-line run, razzle-dazzle pass—but since you are the coach, not the player, you can't directly control offensive and defensive action. You can only send in plays and watch your team execute them.

The second level of play is standard play-calling mode. Here, 200 plays are available in a graphical playbook. In this mode you can be both coach and player, picking the plays and controlling the action on the field.

At the third level, advanced play calling, you pick plays by the numbers and you must control the offensive action; control of defensive action is still optional.

Play picking requires lots of practice and patience. With the playbook open and a page of Xs and Os staring you in the face, you have about 5 seconds to make a choice. The clock always expired before I found the play I wanted, and then Front Page Sports Football made a choice for me. There should be an unofficial time-out, at least in standard mode, to give the slow player a chance to find the right play.

NO FEEDBACK

The play-picking process could also use some feedback. Clicking on a play gives no indication that you've made a choice. The developer says this is so an opponent can't spy on you, but it's annoying.

Action on the field is controlled by joystick or keyboard. The mouse is used only for making menu choices and managing the game.

Two human opponents can play Front Page Sports Football, or you can match wits with the computer; you can also watch as the computer controls both teams. For those who don't want to play every game but still want to complete the season, the computer can simulate all or any part of the schedule. This takes time, though: A 20-MHz 386SX PC took more than 2 hours to simulate the 238 games played in

Almost like TV: The referee makes his report in Front Page Sports Football.

Front Page Sports Football

a regulation season.

Front Page Sports Football has so many features and options that the action on the gridiron seems almost secondary. Rather, this is largely a game for aspiring coaches and managers. You can create entire leagues with up to 28 teams and 1,400 players, draft and trade players, and set schedules. There's a play editor for those who want to design new plays, and reams of statistics (player, team, and league) for those who are fascinated by numbers.

Die-hard fans will love the investment of time and practice that it takes to play this game well.

Front Page Sports Football, *$69.95.* Requires: *640K RAM, DOS 5.0 or later, 8MB hard disk space; mouse and joystick recommended. Dynamix Inc., 1600 Mill Race Dr., Eugene, OR 97403; 503-343-0772; fax, 503-344-1754.*

Circle 483 on reader service card

MICROPROSE SOFTWARE INC.

World Circuit: Grand Prix Race Simulation

Grand Prix auto racing is the ultimate driving challenge, and World Circuit: Grand Prix Race Simulation, from MicroProse Software, is the ultimate Grand Prix simulation. Jump into a Formula One racer, rev up the engine, and put the pedal to the metal for a driving thrill that you won't soon forget.

World Circuit is just that easy: The program has a quick-race mode that gets you moving over the circuit with a minimum of fuss. This is software for those who want to lay rubber as soon as the program is loaded; reading can come later. Each higher level of skill, from rookie to ace, requires more involvement, more practice, and more detailed study of the 160-page manual.

At rookie level, you simply accelerate and steer using a joystick or your keyboard. Damage to the car is ignored, and the PC brakes and shifts for you, although you can choose to take control yourself. At the ace level, you are in full control; even a minor smash-up can end your career.

You can select practice, single race, or the complete Grand Prix circuit. Sixteen cities on the circuit are accurately simulated in 3-D, with variable weather and track conditions. From the 2.3-mile circuit through the streets of Phoenix, Arizona, to the compact course of Monaco with its famous tunnel under the casino, you'll experience the 90-degree turns, bumps, manholes, and uneven surfaces that are unique to Grand Prix auto racing.

Although the teams represented in the software are not the actual ones, the racing dynamics are incredibly lifelike. If you want to get a little grease on your hands, about everything on the Formula One cars can be adjusted. In real Grand Prix cars, for example, the gear ratios are changed for each circuit, and World Circuit allows you to do the same. Likewise, you can control pit stops and tire management at the higher skill levels.

World Circuit is the finest racing software we've seen. It runs best on a fast computer, but there are details that can be turned off so that it runs acceptably on slower machines. For example, the animation frame rate can be lowered and the surface texture of the streets removed to improve the program's performance. World Circuit's 3-D graphics give you a real sense of speed, and sound effects like engine whine and tire squeal contribute even more to the realism. There are no yellow caution flags out for World Circuit; this one gets a checkered winner's flag.

Ready to roll: World Circuit's Grand Prix tour takes you from Phoenix to Monaco.

World Circuit: Grand Prix Race Simulation, *$49.95.* Requires: *1MB RAM, DOS 5.0 or later, 2–8MB hard disk space. MicroProse Software Inc., 180 Lakefront Dr., Hunt Valley, MD, 21030. 800-879-7529, 410-771-0440; fax, 410-771-1174.*

Circle 484 on reader service card

MICROSOFT CORP.

Microsoft Golf

ACCESS SOFTWARE INC.

Links 386 Pro

Last year 24.8 million people drove, whacked, chipped, and putted their collective way through 479 million rounds of golf. If you lack time for the real thing, tee up for the desktop variety with Access's Links 386 Pro for DOS or the Windows version of the same program, Microsoft Golf.

No matter which version you choose, you begin the game by creating a player. In addition to name and gender, you are asked to specify a level of play (beginner, amateur, or pro), tee location, and your choice of up to 14 clubs.

Once the preliminaries are out of the way, the software begins to draw the first hole in realistic detail. Instead of an artist's renderings of a fictitious course, you get digitized images of the famous Torrey Pines links in San Diego.

Select a club, aim your shot, and swing. The swing meter is shaped like the letter *C*; the idea is to click the mouse at the exact bottom and top of the C for a perfect shot.

The big difference between Golf and Access's original golf game, Links: The Challenge of Golf, is that Golf allows you to open and view multiple windows. Choices include a main view of the hole, overhead view, shot information, swing control panel, and the scorecard. Thanks to the Windows environment, each window can be moved and resized to suit your style.

LINKS 386 PRO

Links 386 Pro is not a replacement for Golf or Links; rather, it is an entirely new product. Although the interface looks and works like the other two, Links 386 Pro has new features such as multiple screens, a rotation compass, and options for setting the condition of the greens.

The big change, however, is Links 386 Pro's higher-resolution graphics. The results are dazzling. The grass is grassier, the water is waterier, and the trees are leafier, although the higher resolution won't do a thing to correct your hook.

Links 386 Pro

This is one of the first pieces of entertainment software to use the VL-Bus standards for Super VGA. To run Links 386 Pro, you need a computer with at least a 386 processor and a Super VGA display with a VL-Bus driver. Access includes drivers for many popular video cards.

A conversion utility is included, so you can still use the older, low-resolution courses. All new courses, however, are in the higher-resolution format. A utility converts them to low resolution for Golf and Links. Drawing time is slow—about 10 seconds on a 20-MHz 386SX with 4MB of RAM—but improves significantly with more memory. Links 386 Pro is written in true 32-bit code, so it automatically recognizes up to 8MB.

Like Golf, Links 386 Pro supports multiple views. For example, you can customize your screen to display a view from the tee, an overhead view, a profile, and the scorecard. Ten different views can be arranged according to six different styles, with more than 360 unique combinations possible. One reason to select smaller views is that they draw faster.

Another new feature lets you record and replay games. You can use this to play in tournaments by uploading or downloading games from services such as CompuServe, America Online, and GEnie. In the future, you may be able to play in a foursome with some of the legendary greats.

The play and user interfaces for both products are almost identical, and the retail prices differ by little, so picking a golf game is easy. If you like Windows, buy Microsoft Golf; if you have the hardware, purchase Links 386 Pro; otherwise go with Links: The Challenge of Golf. □

The real course: Links 386 Pro's Harbour Town Golf Course is rendered in high-res detail.

Links 386 Pro, *$69.95.* Requires: *386 processor, 2MB RAM, 8–13MB hard disk space, VL-Bus Super VGA display, mouse, DOS 3.1 or later.*

Links: The Challenge of Golf, *$39.95.* Requires: *640K RAM, 2.5MB hard disk space, DOS 3.1 or later; mouse recommended. Access Software Inc., 4910 W. Amelia Earhart Dr., Salt Lake City, UT 84116; 800-800-4880, 801-359-2900; fax, 801-359-2968.*

Circle 485 on reader service card

Microsoft Golf, *$64.95.* Requires: *2 MB RAM, EGA or VGA, 4.5MB hard disk space, mouse, DOS 3.1 or later, Microsoft Windows 3.0 or later. Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-426-9400, 206-882-8080; fax, 206-936-7329.*

Circle 486 on reader service card

MOVING?

Please write to: PC Magazine, P.O. Box 54093, Boulder, CO 80322. Include your mailing label from a recent issue of PC Magazine for faster service. Please allow up to 60 days for change of address to take place.

Abort, Retry, Fail?

THE LIGHTER SIDE OF PERSONAL COMPUTING

By Don Willmott

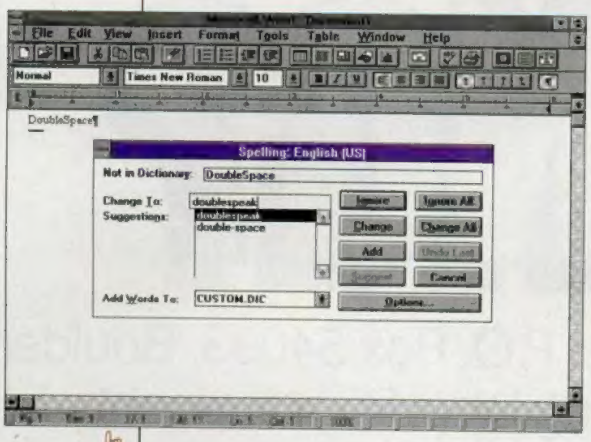
Anonymous E-Mail Notice

"I have SOLID information that Windows NT will be distributed in chain letter form. Within 60 days you will receive a letter containing a list of names and addresses, along with instructions to write 10 lines of C code and send them to the address at the top of the list before you add your name at the bottom and mail copies to 84 of your friends. Having done that you will simply sit back and wait a few weeks to receive 12.5 million lines of NT source code, which you will then compile and link to form your NT system."

No. You give us a drive with a cover.

Classified Intelligence

"FRY MASTER computer, 3 well deepfryer, 3 years old. Make offer."
—*ARGUS OBSERVER, ONTARIO OREGON*



Ask Microsoft Word for Windows to spell-check the word DoubleSpace (MS-DOS 6.0's data compression utility) and here's what you get.

Amazing Facts

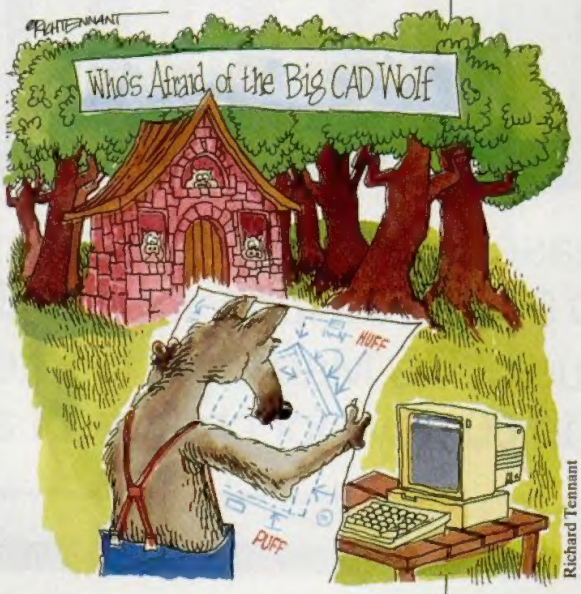
"Arnold Stitt. . . learned. . . that ostrich hide is second only to elephant hide in toughness; that one ostrich hide will make six pairs of boots; and that feathers are used in computer software."
—*BIRMINGHAM POST-HERALD*

D BEAUTY BRIGHT
Future models will delight in this lighted case full of beauty props: brush, comb, battery-operated dryer, make-believe lipstick, compact, decorative perfume bottle, 4 curlers and 2 barrettes. Uses batteries (not included). Ages 3–8 yrs. Ca

Hey, did Toshiba merge with Mattel?

Calling Gloria Steinem

AIdeaLabs' $69.95 Girlfriend is "the world's first artificially intelligent virtual woman." Among Lisa's features:
"Many outfits and poses."
"See how she analyzes your sentences and watch her brain work!"
"She responds to you after a few seconds."
"Find out what mood she is in—graphically!"
"Tell her to do things, and then watch!"



Richard Tennant

If your entry is used, we'll send you $50 and a *PC Magazine* T-shirt. Send your entries to Abort, Retry, Fail?, *PC Magazine*, One Park Ave., New York, NY 10016-5802. Winners this issue: Jeff Hodgson, Paul D. LeBoutillier, and Michael Van Dyk.

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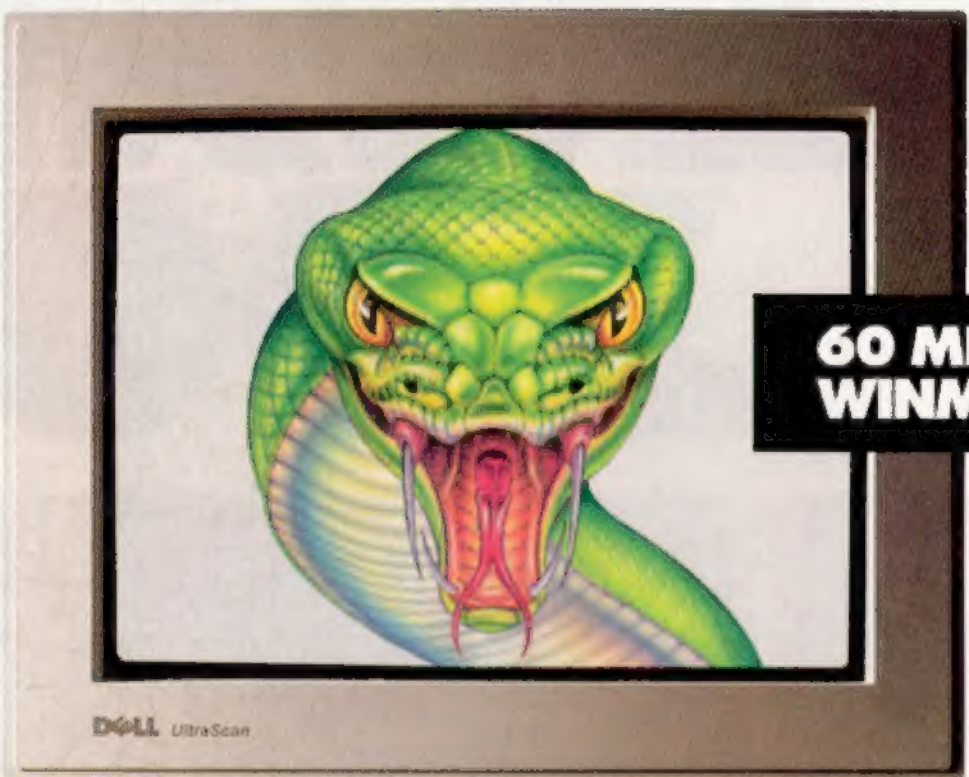

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intel inside

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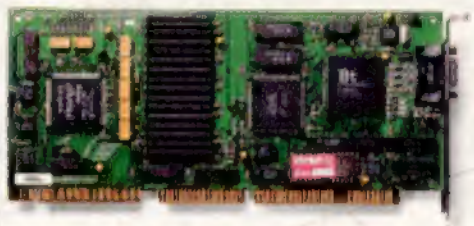

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*†Promotional price expires 9/30/93. *Performance measured by running WinBench version 3.11 at 1024 x 768, 256 colors. **Dell assumes no responsibility for face-warping acceleration injuries.*